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Australia

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RADIO, TELEVISION and Hobbies

MAY, 1965
2/6
Vol. 27 No. 2

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AMPLIFIER

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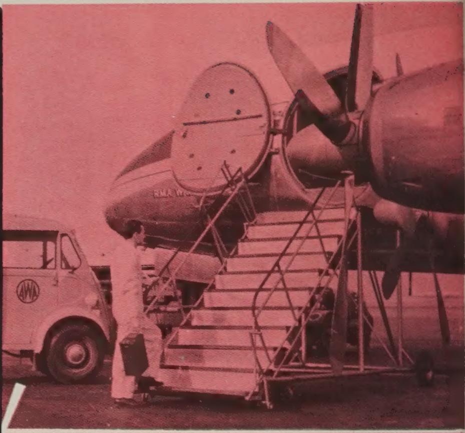

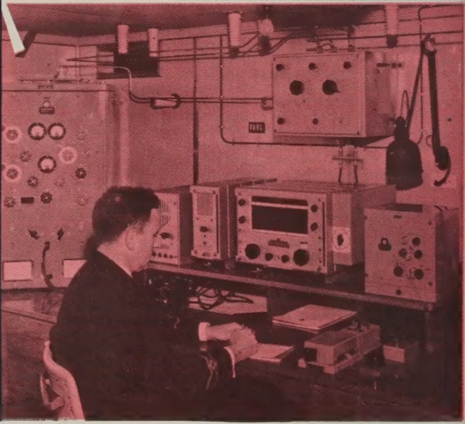

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Editor:
NEVILLE WILLIAMS
M.I.R.E.E. (Aust.)
(VK2XV).

Assistant Editor:
PHILIP WATSON A.M.I.R.E.E. (Aust.) (VK2ZPW).

Technical Editor:
JAMIESON ROWE B.Sc. (Tech.) Grad. I.R.E.E. (Aust.).

Technical Staff:
KEITH JEFFCOAT (VK2BK).
KEITH WOODWARD (VK2ZAU).
JOHN DAVIDSON (VK2ZJE).
ROBERT FLYNN.

Editorial Offices:
12th Floor, 235-243 Jones St., Broadway, Sydney, Australia. Phone 2-0944. Ext. 2531, 2525-6-7. Postal address, Box 2728, G.P.O., Sydney, Australia. (Re. technical queries see "Answers to Correspondents" page).

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COVER PICTURE

Operation of modern undersea cables depends on repeater/amplifiers spliced into the cable every 20 nautical miles. To minimise risk of failure, the amplifiers are assembled in dust-free rooms, from specially selected components. The amplifier shown is being inspected at the London plant of Standard Telephones and Cables Ltd.

A CENTURY OF CO-OPERATION

IN recent years, we have heard a good deal about ITU—the International Telecommunication Union. In the late 1950s it was much in the news when, among other things, the availability of band-space to licensed amateurs was at stake at an ITU conference. On that occasion, our late Editor, John Moyle, went to Geneva to represent the interests of Australian amateurs.

We have heard a lot, too, about the CCIR, the International Radio Consultative Committee, and the CCITT, the International Telegraph and Telephone Consultative Committee. Every time we switch on a television receiver, we put to practical use standards based on CCIR findings.

It may come as a surprise to realise that these very active international planning groups, this month, celebrate a centenary. It was in 1865 that twenty States met in Paris and, on May 17, founded the International Telegraph Union, laying down the initial set of regulations governing use of the electric telegraph.

In 1885, provisions had to be added to cover international telephony. The turn of the century witnessed the development of wireless transmission, the first international radio regulations in 1906 and adoption of the SOS signal. These regulations were tightened up, incidentally, following the "Titanic" disaster in 1912.

During the 1920s the technically based "CCI" bodies were founded and, in 1932 came the Madrid conference, in which all previous arrangements were fused into a new, unified body—the International Telecommunication Union. 1947 saw foundation of the International Frequency Registration Board (IFRB) and a working agreement reached with the United Nations organisation. Since 1948, the ITU has become centred in Geneva with a permanent administrative council.

If climax is required to the ITU story, it came in 1963 with the Geneva Space Radiocommunication Conference, when some 6000MC of bandwidth, approximating 15 per cent of the total available radio spectrum, was allocated for space communication.

In a world which is so preoccupied by "wars and rumours of wars" the ITU story, chequered though it has been at times, gives some cause for hope. Nations can co-operate, if they want to hard enough!

Williams

May, 1965

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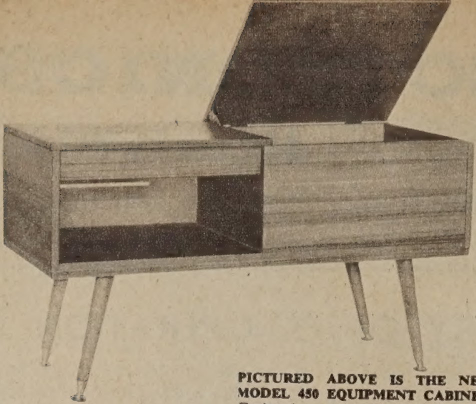

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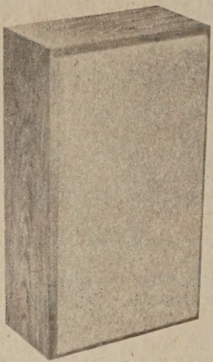

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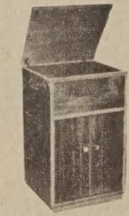

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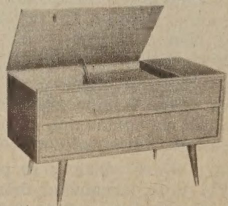

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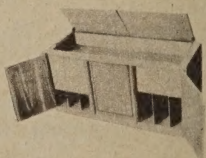

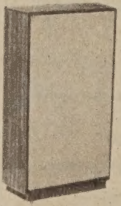

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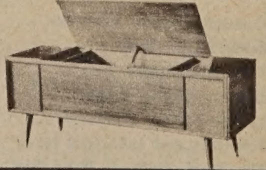

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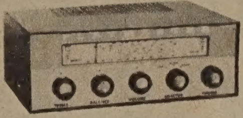

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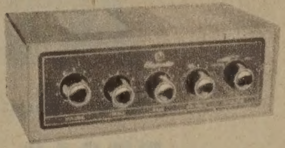

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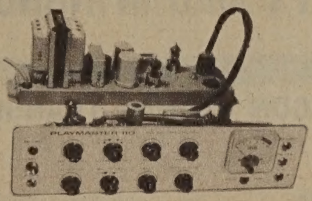

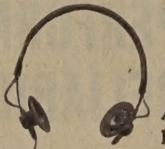

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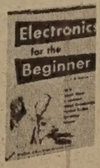

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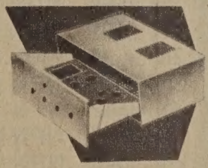

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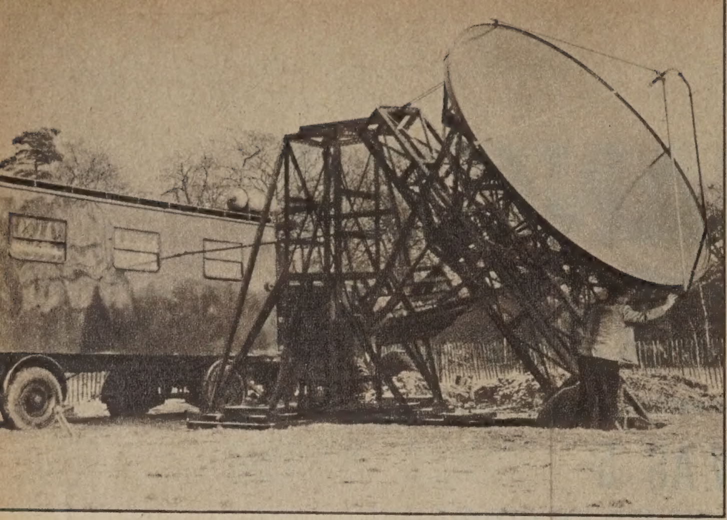


The Birmingham University installation uses an economical 12ft diameter dish aerial and a low power (2KW) transmitter and receiver in the caravan alongside.

Moonbounce technique to aid COMMUNICATIONS RESEARCH

A small team of engineers at Birmingham University, England, has chosen the moon for a series of experiments in long-distance communication. The research will have direct relevance to passing messages between spaceships and may eventually lead to the development of a cheap form of communication between remote communities on earth.

By Brian Cousins

COMMUNICATIONS between two places by voice or telegraph are so much taken for granted in these days of spaceships and hydrogen bombs that few people spare a thought for their importance and for the demands that will be made on communication facilities in the future.

Few people, that is, except those whose job it is to provide the links that girdle the earth and which have become so essential in an age in which time has become so vitally important.

But the simple truth of the matter is that a lot of thinking has to be done about world communications systems, already heavily burdened and likely, in the not distant future, to reach bursting point unless means are found of developing and expanding them.

This is the basic reason for research now being undertaken in the Department of Electronic and Electrical Engineering at Birmingham University, where the moon will be used as a passive communications satellite in a project to examine techniques for long-distance communications.

Long-distance radio communications at present depend largely on the ionosphere, a layer around the earth that has the property of reflecting radio signals, thus making possible the passing of messages between two points which would otherwise be screened from one another by the curvature of the earth.

But the ionosphere is by no means an ideal or a simple medium for communications because it gives rise to echoes and fading and there is interference from atmospherics and man-made electrical disturbances. Neither can it reflect all radio waves but only those in a waveband which is already crowded with long-distance messages.

If we are to win more "cooperation" from the ionosphere, we simply must know more about its peculiarities and its possibilities.

Unfortunately, direct research on long-distance communications by way of the ionosphere raises difficulties, the main one being that it is necessary to have a receiving and transmitting station at widely separated points. The stations therefore need communication to investigate communication!

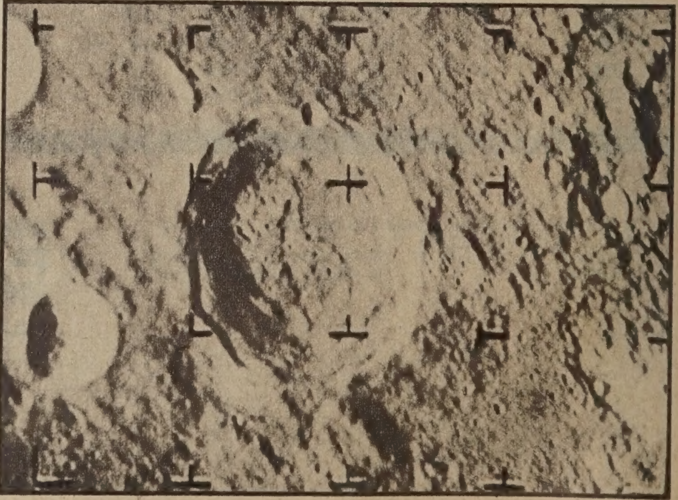
New possibilities for this kind of research are raised by the use of the moon as a reflecting communications satellite. Not only is it possible to have the transmitter and receiver in the same location for experimental purposes but such a link gives a realistic environment for research by presenting many of the problems of ionospheric and long distance transmissions.

This is the main reason why a small team of engineers at the university, led by Mr E. D. R. Shearman, a senior lecturer in the Department of Electronic and Electrical Engineering, has chosen the moon for a series of experiments which are receiving the financial backing of Britain's Department of Scientific and Industrial Research.

Obviously enough, research into long-distance communications using the moon as a reflecting surface will have direct relevance to passing messages between spaceships while it could also lead to the development of a cheap form of communications between remote communities on earth.

The moon has its limitations, however, not the least among them the fact that from any one point on the surface of the earth, it is only available as a communications satellite for less than half the year. When two different points on the earth's surface are considered, it is available for even less time.

Then there are further complications because it has an uneven movement in relation to the earth owing to its elliptical orbit. Sometimes it is coming towards the earth and sometimes going away from it. Thus any signal reflected from



the moon has the same Doppler effect which changes the pitch heard from the whistle of a train passing at speed.

Other factors also influence the quality of the reflected signal. The craters and mountains on the moon produce echoes which compromise both continuous or pulsed transmission.

A clear speech signal sent out from earth returns as if heard in an echoing cellar but with a rapid fluttering superimposed upon it, making it unusable for communication. Short pulses are elongated by the echoes or multiplied in number.

The object of the experiments at the university will be to find ways and means of overcoming these difficulties and, perhaps, generally improve communications over long distances. They will be carried out in three phases.

MOON NOISE

From a field near the university a small dish aerial will receive the noise-like signals which the moon radiates because it is a hot object in a cold sky. This noise is the background interference which the communications signal must exceed to be usable. In the experiment the temperature changes of the moon will be followed during an eclipse to provide information about the origin of the noise.

Not much work has been done on this subject so far and authorities are not entirely in agreement as to whether the temperature of the surface of the moon, which falls considerably during an eclipse, has any bearing on the strength of moon noises. It is, therefore, a vital part of the program.

During the second stage, signals in bursts of two seconds will be transmitted and received back at the university after the 2½sec. time delay involved in the journey to the moon and back to earth.

Characteristics of the returned signals will be examined to find exactly the effects of the various factors which distort them and to seek means of overcoming them.

NEW TECHNIQUE

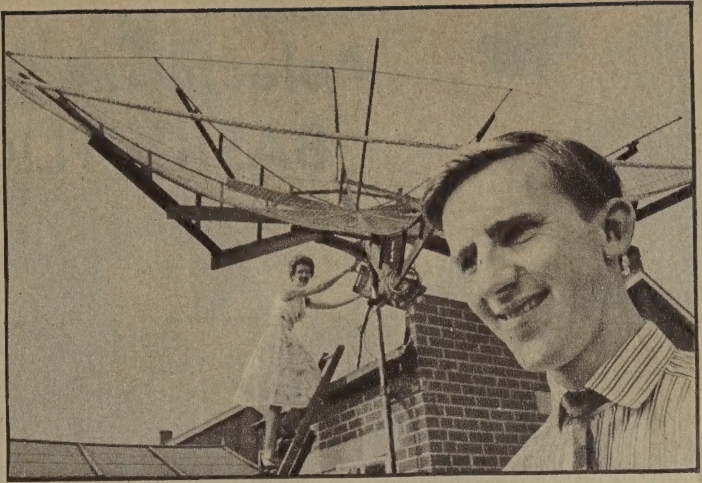
Finally the experiments will reach their climax towards the end of this year, when it is planned to send out telegraph signals using a new technique which, it is hoped, will solve some of the problems associated with communications over long distances.

In this technique the echo characteristics will be continuously measured by the receiver which has been designed to adjust its response automatically from moment to moment so as to reduce the distortions to a minimum.

The equipment used will be a low-powered transmitter of only two kilowatts with a small dish aerial of 12ft diameter, for on the simplicity of the equipment depends any future practical uses to which it might be put.

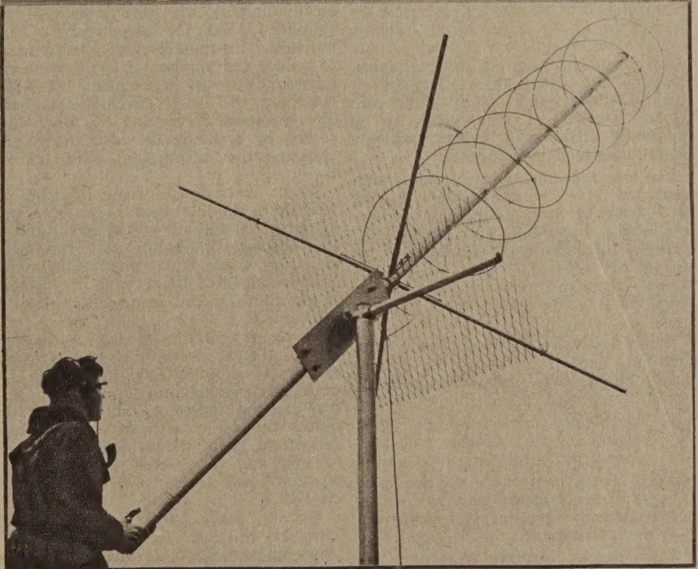
The small isolated communities which could benefit from systems developed as a result of the experiments are not likely to be able to afford to operate and maintain highly complex electronic devices with huge dish aerials controlled by complicated tracking systems. Such equipment would probably make the research work a great deal easier but would defeat one of its main objects.

(Reproduced by arrangement with the "Birmingham Post" and the U.K. Information Service.)



Pictured above is Peter Blair, British radio amateur, who recently bounced a signal off the moon, from his home in Chelmsford, southern England, to a U.S. Government radio telescope in Puerto Rico, in the West Indies. Peter Blair's 28-year-old wife Eileen sat on the roof of the garage and kept the dish pointed in the right direction. The home-made dish cost £5 for materials; the one on which the Morse code signal was picked up cost £3 million!

Tracking Satellites at Melbourne Uni.

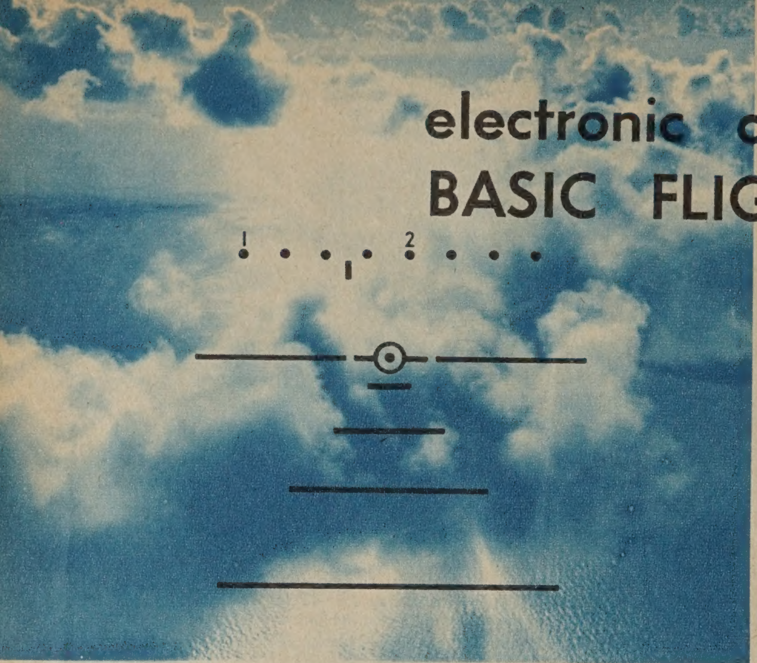


MELBOURNE University's Astronautical Society has the only private station in Australia capable of tracking and receiving weather photographs from American satellites orbiting the earth. Photographs of cloud formations over Victoria, South Australia, and the southern part of New South Wales are passed to the Government Meteorological Bureau.

Supporting the antenna is a 3in aluminium tube, 20 feet long. Polystyrene rod radials are inserted in ⅜in holes along 12 feet of the tube at 120-degree intervals to provide supports for a ¼in aluminium rod helix. A reflector of expanded aluminium is attached at the start of the helix and two feet in front of the antenna pivot. A 3in steel counterweight is mounted on the other side of the pivot.

From a technical standpoint, the Melbourne University antenna exhibits desirable characteristics:

- A high gain (13dB or 20 times) compared with others of the same size.
- Very broad band-width to cope with satellite transmissions on 108, 136, 143 and 160 megacycles. If conventional television-type antennas were used, a different one would be needed for each of these frequencies.
- Simple to design, with no need for subsequent adjustments.
- High rejection of signals coming from directions in which the antenna is not pointed. This is important in view of the electrical interference in the area. ▬



electronic display for BASIC FLIGHT DATA

by David Masters

IN the time most readers will take to finish this first sentence, a Buccaneer aircraft on a low-level strike mission would have travelled well over a mile . . . In modern aircraft things happen quickly; and when things happen as quickly as this, small and usually unnoticed intervals of time, taken up by apparently unimportant events, suddenly assume unexpected significance.

It is true that modern electronic equipment can save the pilot much of the hard work of accurately flying a low-level strike aircraft at high speed. But even so, the pilot needs to refer to his instruments now and again, as well as to look through his windscreen to see where he is going and what is happening.

There are several reasons why the pilot may need to look into the cockpit during flight. His main requirements are:

(a) To monitor flight conditions (e.g., height, speed, course, altitude, range from target or other point).
(b) To assess, control, or change some or all of the quantities in (a).
(c) To monitor power plant behaviour and performance.
(d) To check condition of armaments (including state of missile — e.g., 'armed', etc.) and of associated electronics.

When instrument flying became a normal flight procedure, the pilot was faced with six basic instruments from which to deduce all the relevant facts about the flight of his aircraft. These instruments (A.S.I.,* altimeter, directional gyro or compass, V.S.I.,† turn-and-slip indicator and artificial horizon) were similarly grouped in most aircraft, and were collectively known as the 'flight instruments' or (earlier) the 'Sperry Panel.'

In the course of time the markings on the instruments were improved and simplified, and the disposition of the individual instruments was altered so as to reduce the number of eye movements necessary to an assessment of flight condition. All such developments were directed toward reducing the time consumed by scanning the instruments and assessing the information presented by them.

There is obviously some difficulty in steering a middle course between two extreme conditions — the provision of the absolute minimum of information necessary to enable a pilot to maintain safely controlled flight, and the presentation of far more information than is relevant.

As every pilot who has an instrument rating is aware, it is quite possible to fly a comparatively low-speed aircraft safely using only an A.S.I. and a turn-and-slip indicator; but the art requires the pilot to make fairly subtle deductions from the evidence presented to him and to practise a skilful anticipation and assessment of rates of change.

On the other hand, as soon as an artificial horizon is made available, states and changes of lateral and fore-and-aft level are presented pictorially and instantaneously; much of the aircraft's behaviour can therefore be 'seen' instead of being laboriously deduced from non-symbolic data.

In early and simple aircraft (e.g. light biplanes) it was possible to make an approach and landing 'by the seat of the pants' without referring even to an A.S.I.; in modern aircraft, however, which are faster, more complex, cleaner, less informative 'through the seat of the pants' and demanding of far more sensitive control, the pilot must constanly refer to his instruments during an approach — even in V.M.C.

Whether the need to refer to instruments arises during an approach or in normal flight, the problem of acquiring information from a flight instrument system falls into two main parts:

(a) The process of transferring attention from the outside world to the cockpit presentation and back again.
(b) The nature of the glance into the cockpit.

Obviously, time spent on the process of transferring from one medium of information (the outside world) to another (the instrument panel) is time wasted. Since the human eye can move at speeds of up to 600° per second, transfer time would not at first appear to be significant, even in high-speed aircraft.

Just how significant it is, however, is shown by an investigation which proved that a pilot making an approach to land spent 12 per cent of the approach elapsed time transferring his sight line from cockpit to runway and vice versa.

This astonishing fact means that the pilot approaching to land in a high-speed aircraft is looking at nothing at all during a good deal of a process that calls for continuous and accurate visual judgment. Quantitatively, it is as though a motorist travelling 100 miles at high speed were to drive for eight miles with his eyes shut!

It is not likely that the pilot of a high-speed low-flying aircraft would require to transfer his line of sight from cockpit to outside world and back nearly as often during level flight as during an approach to land. Nevertheless, the time lost in transferring sight line is obviously significant. It would seem that transfer time alone could present a strong argument in favour of some kind of eye-level presentation of flight information.

When a pilot "glances" at his instruments, he undertakes a fairly complicated sequence of actions. From the moment he decides to look at his instruments (and this is the moment at which his attention is removed from the scene in front of him) a number of discreet steps have to be taken before visual flight — using the outside world as a reference — can be fully resumed. The following list shows the separate steps.

(1) Decision to glance into cockpit.
(2) Movement of eyes to transfer sight line from windscreen to instrument panel.
(3) Adjustment of eyes for accommodation (focusing), parallax and aperture.
(4) Scanning of instrument (or instrument array).

---

* **Air Speed Indicator.**
† **Vertical Speed Indicator.**

(5) Interpretation of instrument(s).
(6) Decision to transfer sight line back to original view.
(7) Movement of eyes.
(8) Re-adjustment of accommodation, parallax and aperture.
(9) Interpretation of scene.

This is a "short" list. After stage 5, for example, the pilot may decide to make some adjustment, or to cross-check one set of indications with another; or he may even require to consider the information presented before deciding what action to take. In this case, stages 3, 4 and 5 may have to be repeated—perhaps more than once — before stages 6, 7, 8 and 9 are undertaken.

The time lag in deciding to glance into the cockpit and in completing the transfer of sight line to the panel is of the order of 0.2 seconds; of this time, physical movement of the eyes requires about 0.05 seconds, or possibly a little more, but the elapsed time between decision and initation of eye movement is nearer 0.15 seconds. When the sight line has been directed towards the chosen instrument, the process of accommodation (which, from an elapsed-time point of view includes adjustment of parallax and aperture) will consume another 0.5 seconds. About three-quarters of a second, then, has elapsed before the pilot has begun to read the indication of one instrument.

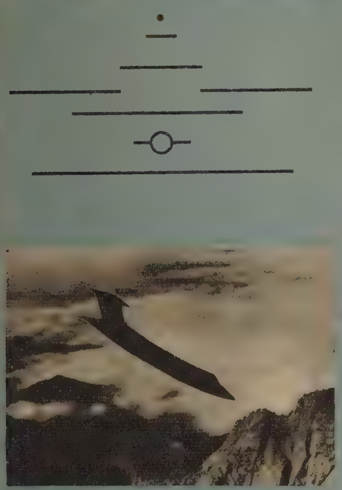
Since it is likely that the pilot will need to read only a small part of an instrument (e.g., part of the speed scale of an A.S.I.) some more time must be spent in finding the part of the scale to be read; and when this has been done, the figures must be interpreted — which involves mental rejection of all the other information displayed by that instrument.

If the glance into the cockpit is for nothing more than a simple check of airspeed, the total time elapsing between "leaving" the outside world and returning to its frames of reference can be 3 to 4 seconds. A modern low-level strike aircraft will cover some three-quarters of a mile in this time.

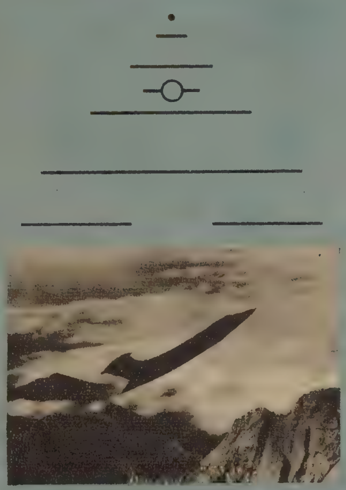
This is hazardous enough; but if the pilot must read more than one instrument, assess the total information presented, decide upon a course of action and initiate it, then the time interval could well be 10 seconds, and the distance covered nearly two miles.

The inescapable conclusion is that the "occasional glance into the cockpit" requires a modern aircraft to be flown for significant perods of time and for quite dangerous distances by a pilot who is, as it were, "not with it."

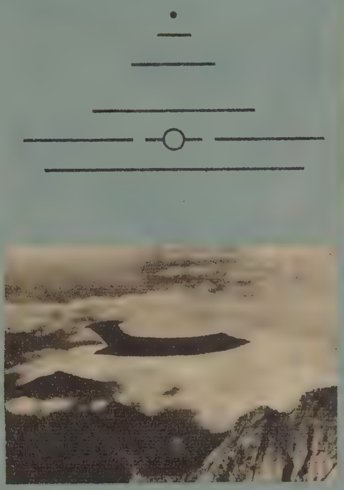
Once the decision to display information to the pilot at eye level has been made, a number of advantages automatically accrue from the technique necessarily employed. For whereas a simple gun-sight graticule can be superimposed



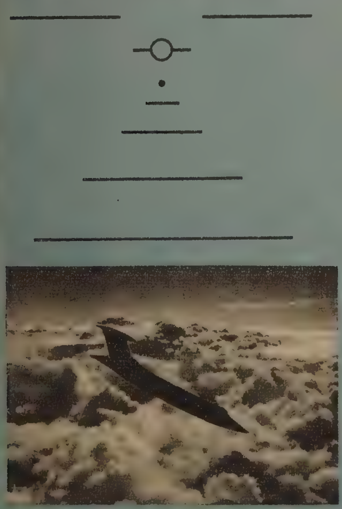
Aircraft low and diving; broken "horizon" line is below the director dot, aircraft symbol is lower still.



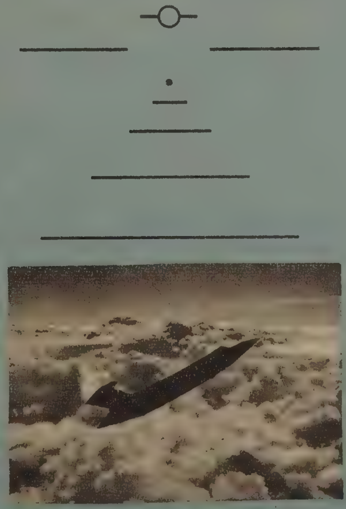
Aircraft low and climbing; broken horizon line is again very low but the aircraft symbol is well above it.



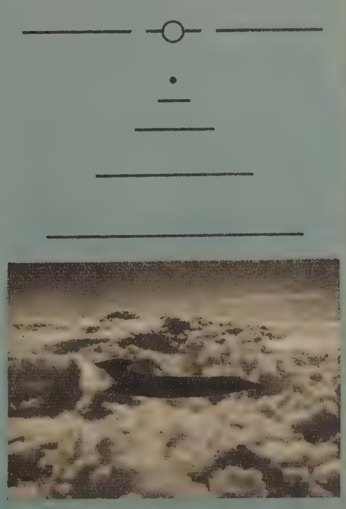
Aircraft is well below its proper altitude but is flying straight and level Plane and "horizon" are in line.



Aircraft high and diving.



Aircraft high and climbing.



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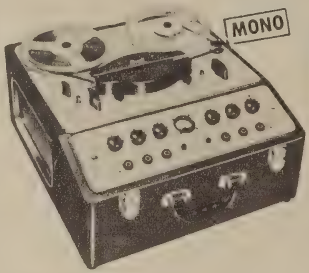

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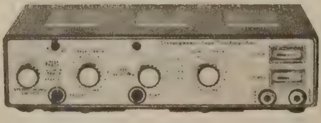

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upon a windscreen without difficulty, the optical system necessary to project an entire instrument panel— or even the minimum desired information — would be far too bulky.

As a result, it has become necessary to display all the information on the end of a small cathode-ray tube and to project this composite image on to the screen. Once this process has been suitably developed, eye-level presentation provides the means for significantly reducing one of the delays not associated with sight-line transfer — the time taken for interpretation.

The display on the screen of the cathode-ray tube is not a picture either of an instrument or of part of an instrument array; it is a symbol or set of symbols designed to convey the information normally presented by the standard instruments. The designer of the equipment can therefore decide how much of the information presented by an instrument should be displayed at eye level, and in what form. If the choice is made wisely, the time taken to read information and to interpret it will be greatly reduced.

For example, it is possible to arrange for the display of a narrow height or air-speed band from which all but the fundamental datum points are excluded.

The pilot is then shown a display consisting of, e.g., two numbers separated by a few dots (whose spacing is obvious), the speed being indicated by a simple line at the relevant point in this skeletal scale.

This presentation is, in effect, not unlike what the pilot's mind "sees" when all the irrelevant information (i.e., that covering a speed or height range not in immediate use) on a normal instrument has been recognised, considered, and rejected by an unconscious thought process.

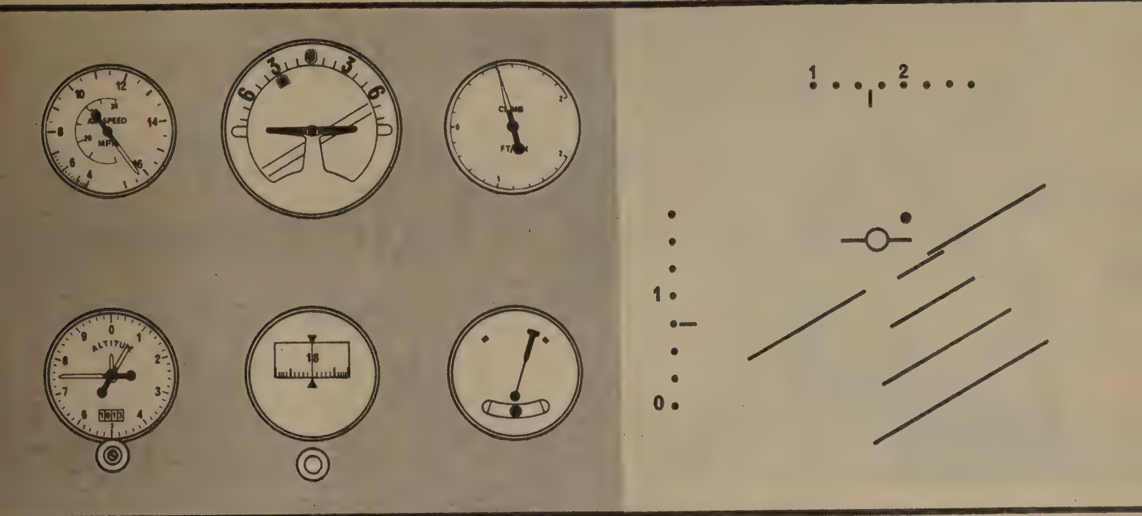
It is possible to go even further and to project only a non-dimensional scale and a moving marker; the pilot is then presented with an immediately recognisable necessity to change a flight condition, and with an equally easily identifiable indication of the direction in which change should be made — all without the complication of figures requiring interpretation. The airspeed scale in the display illustrated is an example of this type of presentation.

Presentation of attitude is normally made by symbols very similar to those employed by the normal artificial horizon, but the main aircraft symbol can be used in conjunction with a moving dot or cross in the same way as in current flight director systems (e.g., Sperry Zero-Reader).

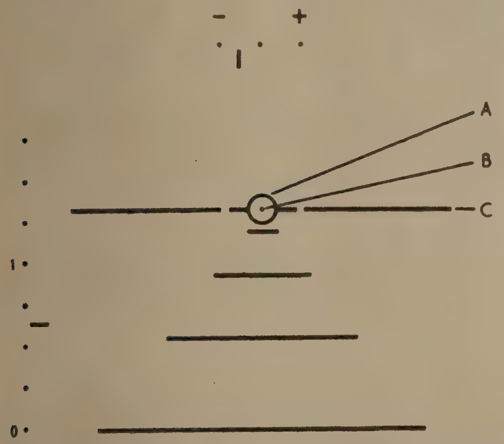
With this form of presentation, the pilot uses his controls in the natural sense to "fly" the aircraft symbol toward the director dot; coincidence of dot and symbols indicates that the aircraft flight path is suited to the desired end—for example, coincidence can mean either that the aircraft (on an approach) is on the centre-line of the runway and at the correct height, or that the course being held will eventually bring it to a desired position.

Obviously, the use of this simple form of presentation, as in the standard Zero-Reader, relieves the pilot of much interpretation and assessment.

The ability to display any desired information, in whatever form is most expedient, confers a remarkable flexi-

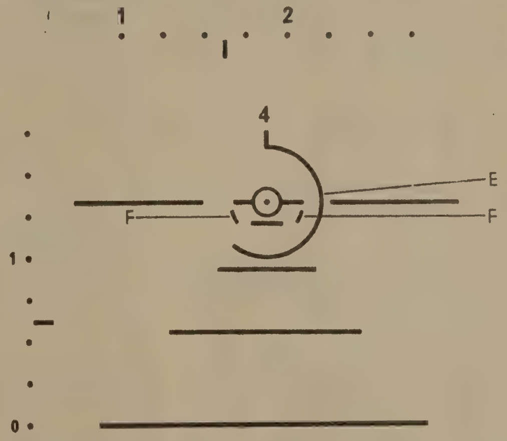


Four of the six instruments shown are needed to provide the pilot with basic information during normal flight manoeuvres. This panel shows that the aircraft is flying at 162 m.p.h. at 750 feet, in a right-hand climbing turn, passing through South. The simple display at right gives the same information. Furthermore, the relative positions of director dot and aircraft symbol show that the aircraft has reached the required height but that it must continue the turn to attain the required heading.



The vertical scale on the left is a simplified altimeter presentation; the horizontal scale shows deviation from a pre-selected air speed.

A. Aircraft symbol.
B. Director dot.
C. Artificial horizon.



The target range can be indicated by the extent to which the circumference of circle (E) is completed. The event markers (F) can be used to remind the pilot to take certain operational actions or to inform him that specific stages of the attack or of weapons system preparation have been reached or completed.

bility upon an eye-level display system. There is naturally much difference of opinion as to the form in which flight information should be presentated.

For example, during an approach to land, a pilot could be presented either with a "zero-reader" type of picture—in which the aircraft symbol (showing pitch and roll attitude in relation to a horizon bar) is flown towards a director dot — or with a display of a pattern imitating conventional runway approach lighting, placed in suitably varying juxtaposition to the aircraft symbol, skeletal height and air speed scales being shown beside the main display in each case.

Similarly, approach marker (radio) beacons could be represented by dots or crosses moving down the screen in imitation of their changing geographical position in relation to the aircraft, or be presented wholly non-pictorially, as "event markers" appearing in fixed positions to indicate specified stages of the approach.

In general terms, and as far as the presentation of flight conditions is concerned, the choice is between simple non-pictorial symbols, and a synthetic "picture" of the outside world in which only the essential features are allowed to reach the screen.

The Hawker Siddeley Buccaneer, the Royal Navy's low-level strike fighter, is the first aircraft in the world to use eye-level presentation as standard equipment in service.

The exact nature of the information displayed in the Buccaneer is classified, but it is obvious that quantities such as range, air speed, bearing of target relative to aircraft, time sequence and state of weapon or weapons system could be presented in a very compact form.

Whatever information is shown, the display is collimated so that it appears to be suspended in space and superimposed upon the view through the windscreen; it is always in focus to the pilot's eye, at a brilliance that can be varied to suit external conditions.

One final and impressive advantage accrues to an electronic eye-level presentation system. There could be half-a-dozen different stages of flight or aircraft operation, each of which calls for certain essential information to be displayed, and to each of which some of the information required by the others is superfluous. At the touch of a selection switch, electronic eye-level presentation will give the pilot only the information that he requires for each phase of flight — and will give it him in the clearest most succinct and most easily assimilable form. ■

The Laser — Light Generator Extraordinary

PART TWO

By Calvin Walters

Laser generators take many forms; crystal, gas, semi-conductor, and liquid. Here two scientists from the General Electric Research Laboratories display a semi-conductor type capable of 1W output when operated at the temperature of liquid nitrogen.

One of the most significant things about the laser is the speed with which it is being developed and new uses being found for it. New discoveries are reported almost daily, and this half of the complete article originally written at the same time as last month's instalment, has needed several additions and revisions since that time in order to keep it as up to date as possible.

BEFORE we detail how the properties of the laser beam have been put to use we will describe some other types of lasers, particularly those which produce a continuous beam of light. One such is the gas (helium-neon) laser, illustrated below.

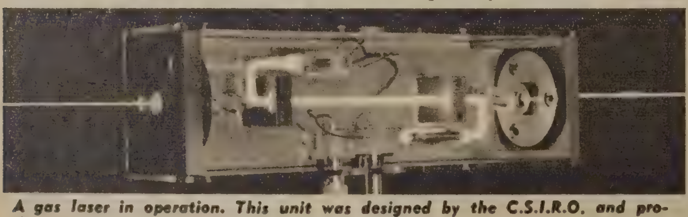
One of the disadvantages of the ruby laser to date has been its intermittent operation. There are two reasons for this; the heat generated within the ruby rod, and which must be dissipated by some cooling system, plus the need to provide a pumping light which would also be continuous in operation. Considerable work has been done in this regard, and the latest report indicates that Siemens and Halske, of Germany, have produced a ruby laser which operates continuously at room temperature, pumped by a 3KW mercury arc lamp.

Nevertheless, the most promising generator of continuous coherent light to date has been the gas laser. The first gas laser was produced in 1961, in the Bell Telephone Laboratories in America, using a mixture of helium and neon gases as the working material.

This helium-neon laser produced infra red radiation and, according to the bulletin "Industrial Research News" issued by C.S.I.R.O. Australia, further research in the Bell Telephone Laboratories led to the production of helium-neon lasers giving an output of red light. A laser of this type, built in 1962 by a group in the Division of Physics of the C.S.I.R.O. led by Dr J. V. Ramsay, was the first gas laser to operate in Australia. This laser is now being manufactured in Australia by Scientific Optical Laboratories of Aust. Pty. Ltd., Adelaide and is shown in our illustration.

In the helium-neon laser, the mixture of gases is contained in a narrow silica tube, about 8 inches long by one eighth of an inch in diameter in the case of the laser illustrated. There is a side tube near each end carrying leads and contacts. Quartz plates, ground and polished so that their surfaces are accurately parallel are attached at the ends of the tube at a critical angle calculated to give minimum loss of light by reflection from the windows. The tube ends are also ground and polished and the end plates are held in position by "optical contact" without cement or mechanical coupling

The gas tube and two mirrors, a flat one at one end and a slightly concave one at the other end, are mounted in a metal frame. Each mirror is made from quartz and, after grinding and polishing, is coated with 13 alternate layers of zinc sulphide and magnesium fluoride, each of precisely controlled thickness. This produces a surface that reflects nearly 99 per cent of the light falling on it and transmits 0.3 per cent. After assembly the air is pumped out and the helium-neon mixture introduced.



A gas laser in operation. This unit was designed by the C.S.I.R.O. and produced commercially by Scientific Optical Laboratories of Australia. Note the thin parallel beam of laser light from each end. (Photo by courtesy, C.S.I.R.O.).

The main difference between the gas laser and the ruby laser is the method of pumping. Whereas in the case of the ruby laser the pumping energy is in the form of light, in the case of the gas laser it is in the form of current through the gas. In the C.S.I.R.O. model, the current is produced by applying a potential difference of 1100 volts between opposite ends of the tube

The resultant current raises the energy of the helium atoms, which then transfer this energy to the neon atoms by colliding with them. This results in a large number of pumped neon atoms, capable of falling to a lower energy state and emitting radiation (in the form of photons) as described last month.

From here on, the action is similar to that of the ruby laser. Some of the pumped atoms emit photons spontaneously. These photons then stimulate other excited neon atoms to emit. Photons emitted along the tube are reflected by the mirrors and passes through the gas again, stimulating further emission. Thus, radiation along the axis of the tube builds up to a high intensity and some of it passes through the mirrors, forming the output beam. The high concentration and parallel nature of the beam can be seen in the picture, where the beam is shown emanating from both ends of the instrument.

NARROW BANDWIDTH

In addition to the coherent nature of laser light and the narrowness of the beam, the light consists essentially of light of a few discreet frequencies, the range at each frequency being unprecedentedly narrow. Several different groups of output frequencies are possible and the desired group is selected by controlling the characteristics of the mirrors and the distance between them. As explained last month, the generator, whether ruby rod or gas tube, functions as a resonant cavity and varying its length — i.e., the distance between the mirrors — is simply a means of adjusting its resonance.

Ruby and gas lasers are not the only sources of coherent light. One of the simplest and most efficient coherent light generators is the semi-conductor junction version; a gallium arsenide p-n diode. (See "Technical Review", R, TV and H., December, 1964.)

Typical Ga As diodes generate light in the 8400 angstrom region, and offer efficiencies in the order of 20 to 50pc. This compares favourably with ruby and similar crystals at 1 to 3pc, and gas at .01 to .1pc.

The output is continuous and may be readily modulated by the application of modulating power directly to the diode current. This is much more convenient than the method which must be adopted for the crystal and gas systems, where the light is passed through a cell which varies its optical transmission according to the modulating power applied to it.

The disadvantages of the semi-conductor laser are a limited power output, a broader spectral spread, and greater divergence of the beam. Nevertheless, its simplicity will no doubt make it ideal for many applications.

LIQUID LASERS

Experiments are also being conducted around a liquid laser. This is a pulse-type generator, light pumped by a xenon tube, which offers efficiencies in the order of 20 to 30pc. Liquid lasers have produced the shortest wavelength so far — 6129 angstroms. More will doubtless be heard of these devices in the future.

Coming to the practical application of lasers, we find that there is considerable research currently being conducted, both to improve and develop those applications which have already been suggested, and also to consider what new applications can be found.

A rather humorous sidelight on this involves the trick of punching holes through several razor blades placed in the beam of a laser focused through a lens. In one laboratory, while awaiting more accurate definitions, the power of a laser was expressed in "Gillettes," according to the number of blades which could be perforated by a focused laser beam.

But there are many applications of more immediate practical value than punching holes in razor blades. One of these is spectrographic analysis, and the application of the laser to this field is best exemplified in the instrument produced by Jarrell-Ash of Massachusetts, U.S.A., and marketed in Australia by the Anax Division of Drug Houses of Australia Ltd., Sydney. This instrument is called a Laser Microprobe and a schematic diagram is given here to illustrate the apparatus and procedure.

It will be recalled from previous articles on electro-spectroanalysis, that portion of a sample is normally vaporised by means of an electric arc. The characteristic colour of the burning vapour is then passed through a spectroscope and the resulting spectrum gives the evidence of the contents of the sample.

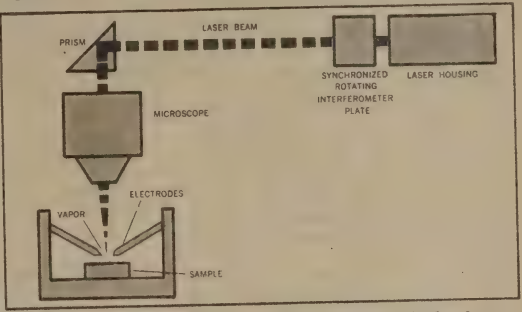
Such equipment, whilst being a great advance on previous methods, suffers from the disadvantage of producing a broad burn on the sample. Also the process is not selective inasmuch as, in the case of some inclusion in the sample for instance, this has to be excised and examined separately.

With the Laser Microprobe, spectral analysis may be conducted on a precise preselected area of the sample. For example, it may be desired to analyse a small impurity dot on a piece of glass, without breaking the glass. Many other examples will suggest themselves to the reader.

The Laser Microprobe uses a laser ruby head, the beam from which is focused on to the sample by passing it backwards through a metallurgical microscope. The sample is placed on the microscope stage, and the area of interest is selected by viewing the sample through the eyepiece. The laser beam is then concentrated on to the sample and the intense heat vaporises the area. The essence of the Jarrell-Ash microprobe development is that raising the temperature vaporises the sample to give a useful spectrum emission.

This is done by causing the vapour to complete the circuit across an auxiliary electrical gap positioned between the sample and the microscope objective. This method permits a spectrum of the sample to be projected in a one shot process.

How selective this apparatus is will be realised from examination of the specifications of the instrument. The sample size need only be one microgramme in weight. The beam will make a crater on the sample of only 50 microns (50 millionths of a metre) in diameter. The estimated output from the laser is only .2 of a joule but as this will vaporise the sample in only 25 one thousandths of a microsecond (25 nanoseconds) the peak power output is of the order of 8 megawatts. Due to attenuation in the lenses etc., the estimated power at the sample is 1 megawatt.



One of the many commercial applications of the laser, the Jarrell-Ash Microphone. It can vaporise, for spectro-analysis, a microscopic amount of virtually any substance, whether basic material or impurity speck.

The microprobe can be usefully employed to examine blemishes on ceramic insulation, spots on clothing, or marks and substances on the flesh or fingernails of criminal suspects. It will operate on conductive and non-conductive samples alike, alive or dead. It is useful for analysis of inclusions in photographic emulsions, analysis of sub-miniaturised sem-conductors, and rapid analysis of mineral and geological samples.

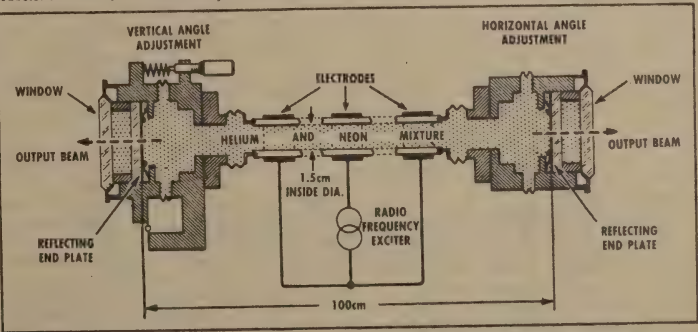
Considerable progress has been made in using the microprobe to examine biological samples such as brain tissue, tumours, etc. The tissues can be progressively examined in situ and the resultant spectrum compared with that of normal tissue. In this way chemicals in tissue can be analysed as well as foreign matter.

In the U.S.A. a miniaturised laser has been recently developed in which the whole laser head has been reduced to a cylinder about 1¼ inches long by ¼ inch in diameter. This has been incorporated in an ophthalmoscope where it has been used to carry out a form of microwelding in eye surgery. (See picture on page 12 of last month's article.) Clinical trials have shown that it can be extremely valuable in cases of retinal detachment, which normally results in blindness.

Because of the ability of the beam to be focused on to a very small area the possibility of using the system to drill small holes has been explored. Hole diameters in the order of microns have been drilled in fine wire for sub-miniaturised electronic equipment. Welding of metal by the laser has led to the development of limited commercial machines in America. Promise has also been shown in the use of the laser beam for metal removal such as machining of metal parts.

As previously pointed out, the difference to date between the ruby laser and the helium-neon laser has been that the latter is continuous in its operation whilst the former is not. This has led to interesting possibilities for the use of the helium-neon laser.

It is being used overseas as a spectroscopic line standard, because the spectral width of the output is extremely narrow. It can be used for measuring distances in much the same way as radar, because of the highly directional properties of the beam. Gas lasers are



A detailed drawing of a typical gas Laser. Note the flexible couplings at each end to allow critical adjustment of the reflecting end plates. Their position must be accurate to within a fraction of the wavelength of the light being generated if the cavity is to be truly resonant. (Bell Laboratories).

LASER PRODUCES 3D IMAGE

According to the latest report from overseas, the laser has chalked up another victory — and in a completely unexpected quarter. "Free vision" three dimensional photography — something which scientists have dreamed about for years — looks like becoming a reality at last.

"Free vision 3D" is the name given to the ideal method of three dimensional photography whereby the viewer is presented with a three dimensional image without any viewing restrictions of any kind; no special glasses, critical viewing positions, eye training, or anything of a like nature. Just a three dimensional image as easy to view as the conventional two dimensional one.

Acknowledged as one of the hardest scientific nuts to crack, and regarded by many as one of the "impossibles," it has long been lumped in with perpetual motion and similar scientific dreams which are "invented" or "discovered" with monotonous regularity, only to fall by the wayside when put to the test.

This report comes from the American magazine "Electronics," and is by their Advanced Technology Editor, George V. Novotny. While necessarily in condensed form, enough information is given to suggest that the basic principles are sound, even if the practical application is still a long way off. The report is as follows:

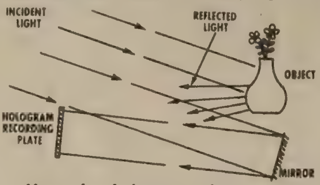
In a Boston hotel suite recently, a few dozen normally sedate scientists and engineers were playing with a toy locomotive, a toy train conductor and other such items.

The train wasn't really there at all. But if you stood in exactly the right place and looked into a piece of equipment you would have seen it, real as life. The toys had been "reconstructed" by a technique that looks simple, yet is one of the most advanced developments in modern science.

The "reconstruction" was done with a gas laser made by the Perkin-Elmer Corp., and a "hologram," a special photographic plate made by researchers at the University of Michigan.

When you looked at the hologram, illuminated from behind by a gas laser, you saw the train and conductor toys right there on the table, in three dimensions. If you wanted to see what was behind the little man, or in front of the toy locomotive, you simply moved your head to see them. No need for viewing glasses, double images or squinting.

The new technique of recording objects — Prof. George W. Stroke and Emmett Leith of Michigan call it holography — uses laser light, ordinary black-and-white photographic plates, and no lenses or camera equipment. The laser beam is channeled to illuminate the subject and the photographic plate. Because its light is coherent, it establishes an interference pattern on the photographic plate. This pattern is what the plate records, and it bears no resemblance at all to the subject. In ordinary light it doesn't look like anything. But shine a coherent laser beam through it, and the subject springs into being.



How the hologram plate is produced.

Because there are no lenses, each point on the object is recorded all over the photographic plate. So you can take a hologram and cut it in half — or in a dozen pieces — and each piece will still show the entire object from a slightly different point of view, with only a little loss of sharpness.

("Electronics," November 30, 1964.)

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also being applied to metrology (physical measurement) and the control of machine tools.

Of great interest is the possibility of using the gas laser beam for communications. With the gas laser designed at the C.S.I.R.O., frequency modulation has been applied successfully over short distances, and in America one unit has been used to transmit both speech and video by modulating the beam output, which is detected using a simple photosensitive semi-conductor device placed some distance away.

"Interest in this application stems from the very high potential carrier frequency afforded by the laser beam (approx. 10^{14} cycles per second) which will enable many more communication channels to be simultaneously transmitted than are available today. Its application, however, is dependent upon very high frequency modulation and detection techniques and also upon the propagation characteristics of the beam in various media.

"Although the output can be readily detected with the eye at considerable distances, the light is readily scattered by particles in the atmosphere. It is unlikely, therefore, that the beam could be used to transmit information directly through atmospheric disturbances. These difficulties may well overcome by the use of optical waveguide techniques." ("Engineering" July, 1964)

Bela A. Lengyel in his book on lasers estimates that, if proper methods of modulation and demodulation were found that laser light, a single laser could replace all the present information-carrying systems between the east and west coast of the United States. Intense investigation is being conducted along these lines and there seems little doubt that a successful method will eventuate.

In fact, at the time of writing, two reports just to hand indicate the speed with which things are moving in his field. From the British "Electronics Weekly" comes a report from the Texas Instruments company of the successful trasmission of seven TV channels on a single laser beam.

"Seven TV channels have been carried simultaneously on a single Laser beam in recent demonstrations at the U.S. Army Electronics Command Laboratories, using new modulation-demodulation equipment developed by Texas Instruments.

"All seven New York TV channels, with accompanying sound, were carried on the same beam. Although transmissions have so far been confined within one room, it is claimed that distances of several miles could be spanned in the open atmosphere and unlimited distances covered by using relay stations or light pipes.

"In the current demonstrations the incoming signals from New York's seven TV channels, spread over a bandwidth of nearly 200MC, were fed through a conventional TV aerial on the roof of the laboratory building, and then through a pre-amplifier and amplifier.

FIRST TIME

"This is believed to be the first time that more than one TV channel has been successfully carried on a laser beam. Previous attempts have failed due to excessive heating of the modulation crystals.

"This problem has been overcome through low voltage operation of the device—using only about 20 volts instead of about 1,000 volts. To achieve such low power operation the modulator makes use of the 'Pockels Effect' in a pair of matched potassium dihydrogen phosphate (KDP) crystals in a special 45-degree Z-cut.

"The demodulator is essentially a standard, but specially selected, Texas Instrument silicon photodiode, operated in an avalanche condition to improve sensitivity. The laser is a Spectra-Physics single mode helium-neon unit with a wavelength of 6,328 angstroms.

"The company claims that the mod-demod equipment could be used with any standard commercial laser."

And from the American magazine "Electronics" comes a report from Sylvania Electronics Systems describing the construction of a laser TV link using "off-the-shelf" equipment.

Apart from using off-the-shelf equipment, the main feature of this experiment is that the signals were transmitted through the atmosphere for a distance of 6,000 feet, and produced excellent picture definition, both day and night. The modulator was a low power KDP cell which would appear to be similar to that used by Texas Instruments.

Although the use of a laser in military operations as a "death ray" is most unlikely, it has an interesting application in the process called "ranging" or the determination of the position of distant objects. This has been done successfully at the Hughes Research Laboratories in U.S.A. over a distance of 3,000 metres in daylight and 11,200 metres at night, using accurately timed pulses.

Because of the comparative newness of the laser commercial and scientific use has reached only a limited stage of development. Intensive research is being carried out all over the world and new applications are being found. When suitable equipment has been developed for the use of the potentials in the laser beam, there should be great changes in many industrial techniques. ■

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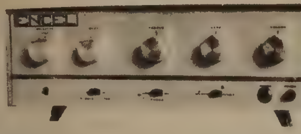

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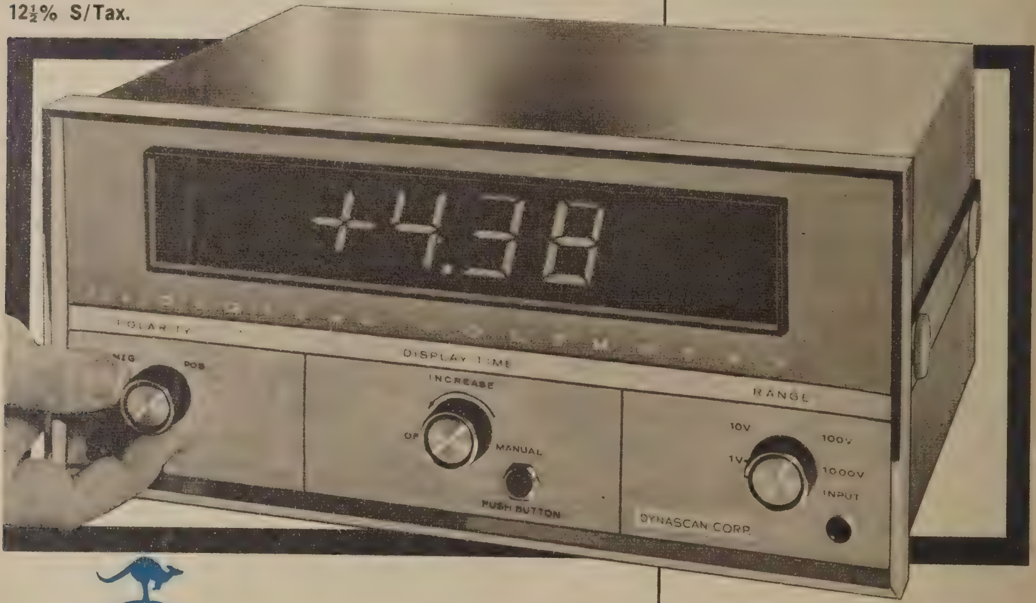

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EP12-65

Technical Review

FLYING "CLOCK" CHECKS U.S.-EUROPEAN TIME

The problem of correlating the time of day at widely separated locations with great accuracy is one that has absorbed chronologists, navigators, astronomers and cartographers for hundreds of years. Alan S. Bagley and Leonard S. Cutler of the Hewlett-Packard company, U.S.A., describe how modern precision time standards can be flown to major centres to improve intercontinental time standards.

IN recent years, intercontinental time of day comparisons gradually reached an accuracy of about one millisecond through use of HF radio signals, the limit being imposed by propagation-time uncertainties of high frequency waves. Two recent means have emerged to achieve intercontinental time of day correlations with accuracy of the order of a few microseconds.

One method has been to fly an accurate clock, set precisely to a given time standard, from point to point, effectively bringing the time standard to each. U.S. Government experiments have used quartz oscillator-driven clocks as well as "atomic" clocks in this matter. In 1960, for example, Reder, Brown, Winkler and Bickart, of the U.S. Army Signal Research and Development Laboratory employed the flying clock method to achieve synchronisation of within about 5 microseconds among Pacific Ocean Area stations. A KC-135 jet tanker, carrying an atomic clock, flew the time from station to station.

In a second method, Telstar I was used as a relay to synchronise clocks between the U.S. and Great Britain. An accuracy of about one microsecond was achieved between these points.

Recently, engineers from the Frequency and Time Laboratories of the Hewlett-Packard Company performed the flying clock experiment anew, this time between the U.S. and continental Europe (Switzerland) using a newly-developed atomic frequency standard and clock. The equipment successfully compared time of day standards of the U.S. with those of Switzerland to an accuracy of about one microsecond. The equipment was sufficiently light and small to be flown as a "passenger" on regularly scheduled passenger airlines.

The atomic clock became available as the result of the development in the Frequency and Time Laboratories of a new cesium beam frequency standard of very high performance. The new standard was to be described in a paper at the International Conference on Chronometry, a conference held every five years at Lausanne, Switzerland. In this way a convenient opportunity arose on the same journey to use the new standard to compare time of day standards in the U.S. and Switzerland.

Two of the new standards were used. Each was combined with an electronic clock which, among other functions, provides accurate electrical "ticks" from the standard frequency for comparison purposes. A special standby battery power supply was included, resulting in a complete atomic clock.

As preparation for the experiment, two newly manufactured standards were carefully checked and their C-fields adjusted to the prescribed value. The standards were then turned on, the first time they had ever operated. Measurements were begun, to compare their frequencies by means of VLF phase comparisons with the frequencies of National Bureau of Standards stations WWVL and WWVB at Boulder, Colorado. No adjustments of any sort were made on the standards. A 12-day comparison with these stations showed the frequency of the standards to be within 5 parts in 10^{12} of the United States Frequency Standard.

On Friday, June 5, 1964, the experiment was begun by taking the standards to San Francisco International Airport by station waggon. At the airport they were placed in passenger seats on a regularly scheduled DC-8 flight bound for Washington, D.C. Power was provided during the flight by the DC-8's electrical system.

In Washington the units were transported to the U.S. Naval Observatory for a comparison against the official U.S. time standards. Records were kept of the comparison for future use.

That evening, the clocks were taken by rental station waggon to New York. During this and other ground transport times throughout the trip, the standards operated from external storage batteries or from internal batteries while being hand-carried. At New York they were placed aboard a regular trans-Atlantic flight, again operating from the plane's power.

The next morning, Saturday, June 6, the standards arrived in Switzerland and were transferred to the Observatoire de Neuchatel. Time of day comparisons were then made at this Swiss observatory, which maintains the Swiss national standard. In addition, one standard was driven to the Laboratoire Suisse de Recherches Horlogeres Neuchatel for a frequency comparison with the long cesium-beam standard maintained there.

From these data, later calculations revealed the time difference between Swiss and U.S. time of day standards. This had already been known, from HF radio comparisons, within about a millisecond. The comparison made with the Hewlett-Packard flying clocks established the value within about one microsecond.

Late Saturday afternoon, the standards were taken from Neuchatel and arrived at the exhibit of the International Conference on Chronometry in Lausanne, Switzerland, on the morning of Sunday, June 7.

At noon on Sunday a chart recording was begun of the difference between the time "ticks" produced by the two standards. This record was made continuously until the morning of Friday, June 12. The record showed that the two standards were within 2 parts in 10^{13} of each other as averaged over the full five days. Again, no effort was made to standardise or synchronise the standards before making the record or at any time before or during the whole experiment.

On Saturday, June 13, the standards were returned to the Observatory in Neuchatel for further measurements against the long cesium-beam standard.

Since the long-beam standard is actually located at the Laboratoire Suisse de Recherches Horlogeres Neuchatel, a telephone line was used in the comparision. The standards were measured as being $(+2 \pm 6) \times 10^{-12}$ and $(+6 \pm 5) \times 10^{-12}$, respectively, with respect to the long-beam standard.

On Monday morning, June 15, the standards were flown to New York, again as "passengers" on a regular flight. From New York they were taken to station WWV at Beltsville, Maryland. Upon arrival, measurements of the time of occurrence of WWV time ticks were made to establish the propagation time between Neuchatel and WWV. This measurement yielded a propagation time of 23,709 ±200 microseconds, the tolerance being mainly the uncertainty in establishing the time of arrival of ticks in Neuchatel. Prior to the experiment the propagation time had been estimated at 22,800 microseconds.

Later Tuesday, the standards were taken to the Naval Observatory for further time checks. On the basis of these measurements the tolerance of approximately 1 microsecond in the correlation between the time of day in the

(Continued overleaf)

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STANDARDS BUREAU SUGGEST LASER AS NEW STANDARD

As mentioned in Calvin Walter's article, elsewhere in this issue, new laser developments and uses are being reported almost daily. From a recent issue of the U.S. "Electronics" comes two reports which emphasise this. One concerns a new use, the other, better performance.

THE laser is making it easier to measure length, and may eventually become the primary standard. Use of lasers in the standards field has been under investigation for years by the National Bureau of Standards.

Recently, for the first time, a helium-neon gas laser was used successfully to measure the length of a standard meter by interferometry. As this new technique is refined further, it may be possible to use the laser as a working standard for calibration measurements. Compared with conventional methods, it is easier to use, more powerful, and has greater range.

Lasers are now being used by commercial companies for measurements on high-precision optical systems — for example, to measure thicknesses of mirror layers at the Bell Telephone Laboratories, and to grind accurately shaped mirrors and lenses at the Perkin-Elmer Corp. However, using laser interferometry to measure lengths of about a meter, and specifically for standards measurements, is an innovation of the National Bureau of Standards.

The international meter is now defined as 1,650,763.73 wavelengths of a certain spectral line given off by krypton-86, an isotope of a rare gas. The interferometric measurement is complex, and the krypton-line source can measure distances only of the order of one-tenth of a meter so that several such measurements have to be added up to make a meter.

GREATER LENGTHS

In contrast, says A. G. McNish, chief of the bureau's metrology division, the gas laser can easily provide accurate measurements of interference of over a meter. If equipment becomes available, he adds, these accurate measurements can be extended to several kilometers. The accuracy of the laser measurement is about the same as the krypton method —one in 10^6—but the extra measurement length and the high beam power of the laser make the laser measurement much easier.

The chief question remaining is whether the gas-laser wavelength can be reproduced as accurately as that of the krypton method. The emission wavelength of a present-day gas laser depends on the dimensions and shape of the tunable resonant cavity, and this is susceptible to changes with environmental variations. The bureau is conducting research into this aspect.

The bureau's gas laser operates at 6,238 angstrom units. During measurement, its mode is kept constant by adjusting the radio-frequency power supply, and the length of its tunable cavity could conceivably be coupled, by a servo loop, to a krypton-86 standard.

The laser beam is used with a special interferometer that splits the beam; half travels across the distance to be measured and then returns to establish a pattern of interference fringes with the other half. The fringes, which occur every half-wavelength, are counted electronically. Conventional light sources, such as krypton arc lamps, produce interference fringes that fade out after a few hundred thousand wavelengths; in contrast, laser interference fringes would remain sharply distinguishable even after many kilometers.

Eventually, says McNish, it may be possible to achieve a redefinition of the international standard meter in terms of a laser-emitted wavelength. Such a major action would involve approval by the International Committee on Weights and Measures, of which the United States is a member. At present, however, the bureau says it is "merely exploring the possibility of such a redefinition."

And from the Bell Telephone Laboratories comes the report of vital laser improvement.

The laboratory claims that it has produced a near perfect mirror which will sharply boost the intensity of a laser.

The mirror-making technique, developed by Bell Labs. researcher, D. L. Perry, is said to produce a mirror so nearly perfect that its light loss cannot be detected.

A laser mirror is made by coating a blank with layers of optically transparent dielectric material that have alternately high and low indexes of refraction. Each dielectric layer is applied in turn by melting it in an evacuated bell jar and allowing it to evaporate on to the blank. The thickness of each layer is kept at one-quarter the wavelength of the laser light so that components of reflected light from each layer add up in phase, thus reinforcing the reflected beam.

The most direct way to increase mirror reflectivity is to increase the number of dielectric layers, but the practical limit up to now has been 15 layers. The benefits of additional layers are negated by increased absorption and increased light scattering.

Light scattering, caused by contaminants and larger particles of dielectric, has been nearly eliminated by two refinements, one in the method of evaporating the dielectric and the other in the method of cleaning the blank. Now any number of layers can be added but, since 100 per cent reflectivity is approached asymptotically, 35 layers is the most used.

One other factor contributes to the success of the mirror: The accuracy with which the thickness of each layer is measured as it is evaporated on to the blank. This is accomplished by a light ratiometer, which compares the output from a gas laser directly, and the light that is reflected from a monitoring slide in the bell jar. As the material on the slide builds up to one-quarter of a wavelength, the reflected light approaches either a maximum or a minimum.

("Electronics," Vol. 37, No. 31.) ■

TIME—*Cont.*

United States and Switzerland was established.

In addition measurements showed that the time kept by the standard was still within 1.5 microseconds of the time kept by the Naval Observatory. In terms of frequency, this measurement meant that the standard was within 2×10^{-12} of the weighted mean of the standards utilised by the Naval Observatory for the complete period from June 5 to June 16.

The time difference on June 16 between station WWV ticks and the Naval Observatory master clock was also measured, the value being 2,397 microseconds.

The next morning, the standards were flown from Washington D.C., to Denver, Colorado, and then driven by car to the Bureau of Standards in Boulder. Checks were there made against the long cesium-beam standard referred to earlier and known as U.S. Frequency Standard No. 3. These checks showed that the frequency of the two standards were $(-3.9 \pm 3) \times 10^{-12}$ and $(-2.7 \pm 3.3) \times 10^{-12}$ with respect to the NBS standard. The measurements were based on 44 and 45 200-second samples, respectively. Measurements were also made of propagation time between Washington and Boulder.

On Thursday the standards were returned to the Hewlett-Packard F and T laboratories in Palo Alto.

The experiment is considered to have been highly successful with the following information established with an accuracy not previously attained:

(a) The time of the day was correlated in Switzerland with that of the United States to an accuracy of about one microsecond.

(b) The propagation time between station WWV and Neuchatel was measured to a tolerance of about 200 microseconds.

(c) the two standards were compared with two well-known long cesium-beam standards and found to be in agreement with them within a few parts in 10^{12}, the second series of measurements being made after a trip of 10-thousand miles and an elapsed time of some 13 days.

(d) The two standards agreed with one another within a few parts in 10^{12} after the full trip.

(e) A measurement to high precision was made to compare the frequencies of a hydrogen maser and a cesium-beam standard.

(f) Lastly, it is understood that the results of the time measurements will be used to obtain better synchronisation by the various agencies in the United States and Europe.

("Hewlett-Packard Journal" Vol. 15, No. 11.) ■

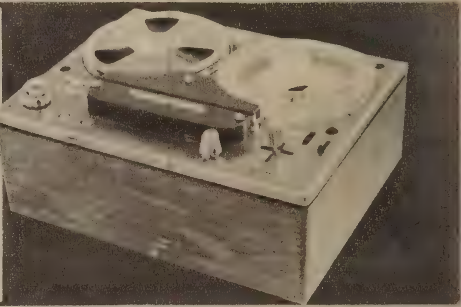
Tandberg

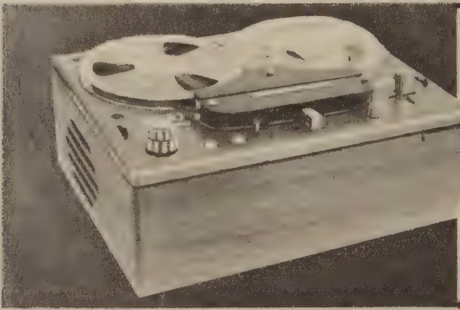
INTERNATIONAL BEST SELLER!

MODEL 64

4 TRACK PROFESSIONAL STEREO RECORDER

Tandberg precision and reliability are exemplified in this fine studio-quality tape recorder. Model 64 has three speeds (7½, 3¾ and 1⅞ i.p.s.) — three separate heads for recording, playback and erase — "Sound on Sound" and mixing facilities — press button electrical track selection — and many other outstanding technical features. Designed for use with external high fidelity amplifiers to provide clear, natural sound reproduction.





MODEL 74B

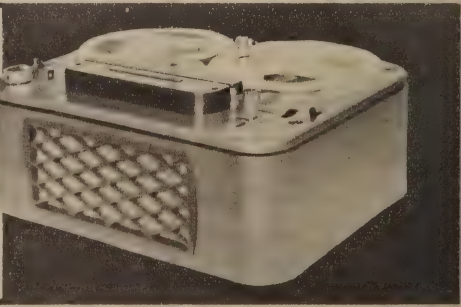
COMPLETE HIGH FIDELITY STEREO SYSTEM

This popular Tandberg recorder provides a complete 4 track stereo or monaural system for clear, natural musical reproduction. It has two output amplifiers, two speakers, three speeds (7½, 3¾ and 1⅞ i.p.s.), Add-a-track facilities and weighs only 27 lbs. You may use the 74B as a stereo record player; this model has unique additional features for language study applications. Write for full details.

MODEL 9

TWO TRACK HIGH FIDELITY MONAURAL RECORDER

This high quality monaural recorder has been designed for the demanding enthusiast. Three speeds, fast wind and rewind, automatic end stop and easy-to-operate controls are important features of this reliable Tandberg recorder. Weighs only 21 lbs. . . . frequency range at 7½ i.p.s. is 20 c/s to 20 kc/s. The perfect monaural recorder . . .



Australian National Distributors

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Tel. 4 3010 (Mr. J. E. Howe)

advantages of the technique for the larger relay installations are not always appreciated in other countries.

With an HF system, the receiver has no VHF or UHF tuner and no audio-frequency circuits other than a loudspeaker, volume control, and isolating components. The audio signals are distributed at a level of about 55 volts along the same pair of wires as the vision signals.

A typical HF television receiver can thus be sold at about £65 in England, or roughly £25 less than a comparable receiver for use with an aerial. On the other hand, a normal receiver can be used with an HF system with the aid of a small frequency-conversion unit. [Central Rediffusion Services Ltd., Carlton House, Lower Regent Street, London, S.W.1.]

1 MHO Transconductance

A new two-stage integrated-circuit amplifier announced by Raytheon in America comes in a standard ¼in diameter TO-5 transistor case, delivers 1 watt of audio at 5 per cent distortion, has an input impedance of greater than one billion megohms and a total transconductance greater than 1 MHO — **one ampere per volt!**

Maximum dissipation of the device is 5 watts, and it has a maximum gain of 150dB. Although mainly intended for use as a replacement for electrometer tubes in measuring and amplifying very low level signals, it has been used in audio circuits with dramatic results. A simple gramophone amplifier can be made up with the "Mho-Amp" as the only active device between the pickup and the speaker.

Of interest regarding its electrometer applications is the noise figure at 1KC with a source impedance of 1 megohm, which is only 2dB. The device is composed of silicon material and is thus quite temperature stable. It features a field-effect input stage to provide the extremely high input impedance. [Australian agents for Raytheon are Hawker de Havilland Australia, Electronics Sales Department, in Birnie Street, Lidcombe, N.S.W.]

Electric Fencing System

An electric fencing system, reported on by Allan Murray in a recent B.B.C. "New Ideas" program, is a combination of two new British products—a flexible plastic fencing post of the pigtail type ("Flexiposts") and a polythene wire netting called "Livestrand."

The system seemed likely to have a wide appeal for mixed and livestock farmers, Murray said. The posts were 3-foot-long rods made entirely from PVC with a 4½-inch steel spike at the base, so that it was impossible to short the current through them. They could be bent through their own arc, and when released sprang upright again. Cattle did not rub against them, because they did not feel "solid," and they were impervious to weather, rot and rust. They were easy to instal single-handed and, being a bright and permanent yellow, were easily visible.

The "Livestrand" netting was made by a patented process that ensured great strength and stability. Six horizontal lines of polythene wire were braced at short intervals by vertical lines of non-conducting polythene wire. The lowest horizontal was never electrified — it was a direct earth return. The others could be linked together by special clips for improved efficiency, or, depending on the height of the vegetation, all horizontals except the top two could be converted into earth returns simply by unclipping them.

"It is a system that makes for highly effective conduction over long distances," said Murray. "It is hard to short out or earth accidentally. The lines don't distort when they are tensioned and the netting does not tangle when it is folded and unfolded."

Safety Goggles

New polycarbonate protective lenses for safety goggles give a tensile strength of between 8,500 and 9,500lb per sq. in. and can withstand the impact of a steel ball shot from a rifle.

Available from a British manufacturer, they retain their tensile strength at high temperatures, and are resistant to most chemicals. [Combined Optical Industries Ltd., Bath Road, Slough, Buckinghamshire, England. Australian Agents: Australian Optical Co. Ltd., 16-22 Australia Street, Camperdown. N.S.W.]

Miniature Electrocardioscope

A new electrocardioscope announced by the Westinghouse Electric Corporation is small enough to be slipped into the doctor's little black bag and taken along on house calls. Called the "Miniscope," the unit measures only 7 by 5 by 2 inches, weighs only 3 pounds and is expected to retail in America for about 380 dollars.

It operates from four rechargeable flashlight cells and displays the electrocardiogram of the patient on a small cathode-ray tube provided with a magnifier. Suction type electrodes are supplied, and the instrument has only two control knobs — one for centering the pattern and the other for adjusting the height.

Although it does not provide a calibrated paper record of the electrocardiogram, the Miniscope has been found to be very useful for clinical observations and preliminary diagnoses. Initial units are being used in Baltimore city hospitals. [Westinghouse Electric Corp. is represented in Australia by Email Limited, of Joynton Avenue, Waterloo, N.S.W.]

Automation In Shipping

Today, the fully automated ship is a technical possibility, but not a realistic proposition. The enormous cost involved in putting such ships to sea will prohibit their introduction for some time to come.

Britain, with the largest marine fleet in the world, has concentrated her commercial efforts almost entirely on the economic role of automation. A recent design study took the case of a diesel-engined merchantman with a normal engine-room staff of between seven and ten engineer officers, three greasers, two donkeymen and a storekeeper.

The introduction of a comparatively modest engine instrumentation and control system would allow the staff to be cut to one instead of two engineers per watch, plus two greasers—a saving of five men. Crew quarters would be reduced in proportion, giving a saving in shipbuilding cost.

These direct savings, without the potential increase in the operating efficiency of the engines through automatic control, would recover the capital investment within five years and would represent a profit of £10,000 annually thereafter for the life of the ship. [Sperry Gyroscope Co. Ltd., Great West Road, Brentford, Middlesex, England. Australian agent: National Instrument Co. Pty. Ltd., 1 Sydney Street, Marrickville, N.S.W.]

TV Antenna Tests

As with Melbourne's Channel 0, Amalgamated Wireless (Australasia) Ltd. used a helicopter to prove the radiation pattern of another television transmitting antenna. The antenna in Artarmon, N.S.W., will be shared by United Telecasters Sydney Ltd. TEN 10, which went on air on April 5, and by Amalgamated Television Services Pty. Ltd. ATN 7, which will transfer to the site later this year.

By employing the helicopter, work which normally would

Taken from a second helicopter, this picture shows the test helicopter plotting the radiation pattern of the joint channel 7/channel 10 aerial.

Further development of the frame grid technique has now made it possible to reduce the electrode diameter to such an extent that a fully separated triode section can be included in the same envelope without impairing the performance of the pentode section. In addition, this new advance has made it possible to develop a frame grid video amplifier, combined with an RF pentode.

Mullard DECAL
10 PIN VALVES

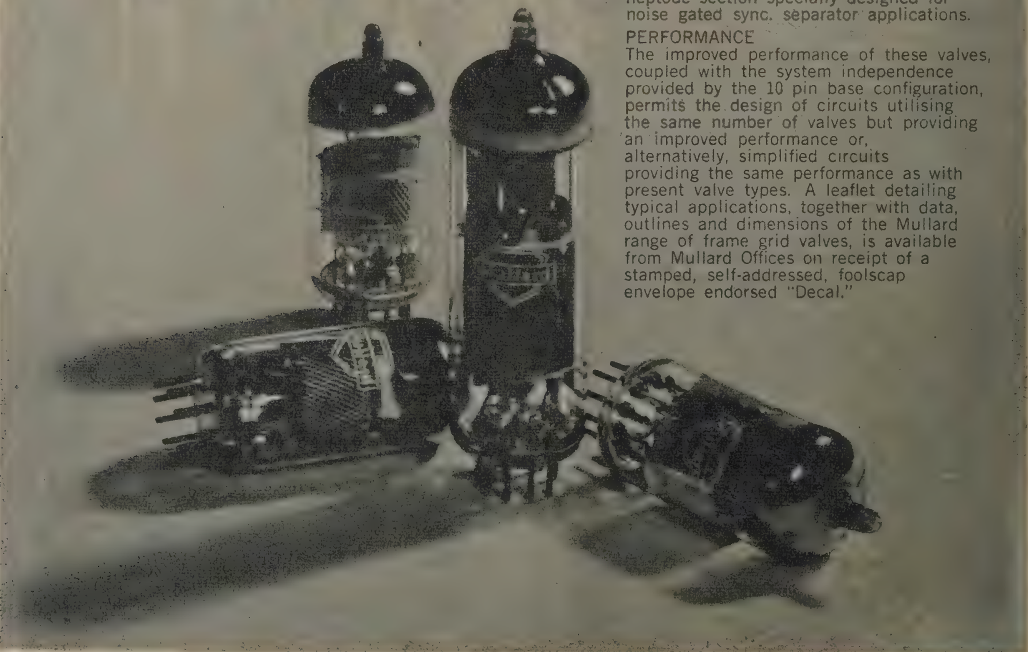
DOUBLE-PENTODE 6Y9
The double-pentode EFL200/6Y9 contains dissimilar pentodes with one section designed for video output service and the other an RF amplifier suitable for sync. separator, AGC or sound IF amplifier applications.

TRIODE-PENTODE 6X9
The triode-pentode ECF200/6X9 contains a sharp cut-off pentode section similar to the frame grid valve 6EJ7 vision IF and a triode section with a μ of 55, particularly suited for AGC and noise inverter service.

TRIODE-PENTODE 6U9
The triode-pentode ECF201 6U9 contains a variable μ pentode section similar to the frame grid valve 6EH7 vision IF and a triode section with a high mutual conductance, specially designed for pulse applications.

TRIODE-HEPTODE 6V9
The triode-heptode ECH200/6V9 has a triode section providing sufficient anode current to drive all conventional phase discriminator circuits and contains a heptode section specially designed for noise gated sync. separator applications.

PERFORMANCE
The improved performance of these valves, coupled with the system independence provided by the 10 pin base configuration, permits the design of circuits utilising the same number of valves but providing an improved performance or, alternatively, simplified circuits providing the same performance as with present valve types. A leaflet detailing typical applications, together with data, outlines and dimensions of the Mullard range of frame grid valves, is available from Mullard Offices on receipt of a stamped, self-addressed, foolscap envelope endorsed "Decal."



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M152

SCIENTIFIC NEWS—cont.

have occupied three to four weeks was completed in four hours. Previously, tests of this type were carried out using a van fitted with special receiving equipment which measured the signal strength of a transmitter at many selected points.

The recent tests modified this technique by employing a low-power transmitter fitted in the helicopter. The television station's antenna was used as a receiving aerial. Signals from the helicopter were logged continuously on a pen recorder, while the pilot's positional information was recorded on tape.

The aircraft flew at 60mph on a constant radius of two miles at an altitude of about 900 feet.

Simulates Data

The first communications data simulator capable of generating telegraph and high speed data test signals has been developed by the Westrex Communications division of Litton Industries, of 1 LeFevre Lane, New Rochelle, New York.

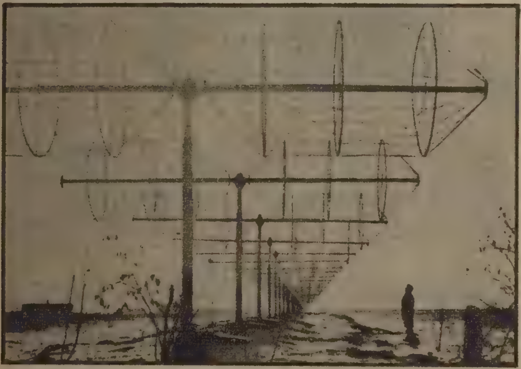
The compact Model 954 simulator is designed primarily for use in communications centres where both telegraph and high speed data signals are generated or processed. Test messages are generated externally by a punched paper tape reader, or internally by an electronic test message unit. Up to 49 per cent bias distortion can be introduced in the test message.

The punched paper tape reader permits telegraphic transmission speeds of up to 300 words per minute or eight-bit data speeds of up to 240 bits per second. The electronic test message unit has a fixed message which can be transmitted at speeds of up to 2400 BPS. Any 80-character test message may be generated by changing the electronic test message unit. A combination punched paper tape reader and electronic test message unit also is available.

TV Camera Target Material

A major technical advance in image-orthicon television cameras has been made by the British company that was responsible a few years ago for developing the highly successful 4.5-inch image-orthicon pick-up tubes.

This development comprises an entirely new type of target material which has been called Elcon (from "electric conducting") and with which the operational lives of three-inch and 4.5-inch image-orthicon pick-up tubes can be greatly extended.



This Russian radio telescope, being installed near Kharkhov, U.S.S.R., measures 18,450ft x 18,450ft and occupies some 250 acres of land. Laid out like a giant "T," it will be able to "see" into deepest space.

It has for some time been appreciated that a major problem with image-orthicon tubes using target materials such as enriched soda-glass is that ionic conduction inevitably leads to electrolysis of the glass and consequent long-term migration of sodium ions from the photo-cathode side of the target, producing undesirable effects including sticking, einbrennen, marquage or stampatura.

With Elcon material the charge transfer process is by electronic rather than by ionic conduction, thus eliminating the undesirable effects.

The new target material has a guaranteed operational life of 750 hours, and lives as long as 3,000 to 5,000 hours have been achieved in field trials with pre-production samples. [English Electric Valve Co. Ltd., Chelmsford, Essex, England. In Australia The English Electric Co. Ltd., 365-375 Sussex Street, Sydney.]

Flight Recorder

Flight recorders of British design have been ordered by the United States Air Force for 42 of its Douglas Globemaster transport aircraft.

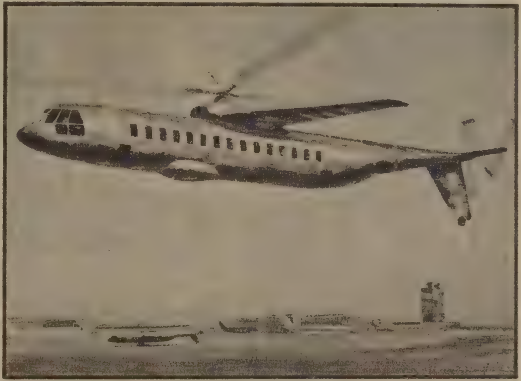
The £½ million sterling order is for the Midas flight recorder which was developed by the British Royston Instrument Company, and is now being made under licence in the United States by the Lockheed Aircraft Service Company.

The recorder, which will be fitted in the tail section of the giant Globemasters, will record up to 15 hours of flight data on 86 aircraft and engine operations. It will also record voices; the unit includes a crash position indicator beacon to aid location and recovery of an aircraft after a crash at sea. [Royston Instrument Company, Canada Road, Byfleet, Weybridge, Surrey, England.]

Travelling Wave Tube

Mullard has developed a new travelling wave tube which has a saturated output power of 20 watts—approximately double that of previous telecommunication types. The firm says the tube permits either more communication channels or a longer distance microwave link.

The new wave tube operates in the frequency range 3.7 to 4.2 gigacycles per second. Complementary to it is a tube of the same power output, but covering the range 5.9 to 6.5 gigacycles. Both tubes are said to have extremely low noise levels. They use natural cooling if horizontally mounted and assisted cooling in the vertical position. [Mullard Aust. Pty. Ltd., 43 Clarence Street, Sydney.]



The Lockheed Company is currently looking at the possibilities of a 60-passenger air-bus, which they refer to as a "Metroplane." It could take off and land vertically, using its helicopter type rotor but travel the intermediate distance as a fixed-wing craft, with the rotor blades folded. Range would be in the 500-to-1,300-mile bracket.

Temperature Control

A small, low cost, self-contained temperature control unit incorporating a mechanical stirrer has been specially developed in Britain for the photographic and chemical process industries.

The unit is designed to be mounted across the corner of rectangular photographic developing or processing baths. It can also be clamped to the edge of a sink or other container to quickly and simply convert any vessel holding from 3-40 gallons into a thermostatically controlled processing bath. Temperatures between 15-95 degrees Centigrade can be maintained within a tolerance of 0.4 degrees. [Lee-Smith Photomechanics Ltd., Lyon Way, Hatfield Road, St. Albans, Hertfordshire, England.]

Continuous Copy Camera

A continuous strip copy camera is shutterless and operates by moving the film across a slit as the camera travels past the objects being photographed. The camera is believed to be the first of its kind by the makers who claim complete freedom from banding in the image, full control of exposure and high resolution.

Developed from an aerial reconnaissance instrument, it is expected to find use as a generator of simulator films, for copying large sections of graphic material and for roadway surveys, etc. Makers are Chicago Aerial Industries, 550 West Northwest Highway, Barrington, Illinois, U.S.A.

"Black Light" Insect Killer

Though it is well known that many flying insects are attracted to light, it is a relatively recent discovery that they are drawn by a light wave of 3,654 angstroms which is present in the ultraviolet range of the spectrum. This knowledge is put to work in a new insect-killing device called Luralight.

Luralights, it is stated, employ special bulbs, but as the so-called "black light" which they emit is invisible to the human eye, a little visible light is added to enable the operator to check that the bulbs are functioning. They are designed to project their rays in every direction, and to work—at night—for long periods with minimal attention and maintenance. Current consumption is low according to the British agent, Reeve Angel International, of 9 Bridewell Place, London, E.C.4, England.

MODEL **M-8**

SEMI-PROFESSIONAL

Vertical stereo creates a new sound harmony, enabling you to enjoy 3-dimensional concert hall performances. The Cross-Field Head provides perfect Hi-Fi recording at the slow speed of 1-⅞ ips and gives you 8 hours of continuous performance on a single reel. 4-track stereo monaural record/play and our exclusive tape cleaner are included with each M-8 for eliminating squeaking tape noise.

MODEL **345**

PROFESSIONAL

Engineered for professional use, this has every device and feature a professional operator wants in a tape recorder. Amateurs can also enjoy a thrilling professional acoustic experience. Other features include automatic reversing and repeating; 3-head/3-motor 4-track stereo/monaural; built-in 20 W stereo transistorized power amplifier; automatic shut-off; remote control; all push button system; 10½″ reel unit is adaptable.

For detailed information, write to:
AKAI ELECTRIC CO., LTD.
OHTA-KU, TOKYO, JAPAN
MAGNECORD AUSTRALASIA PTY LTD.
158 Clarence Street, Sydney Tel. 29 5127

Heated Ceilings

Electrically heated ceilings are being produced in Britain. The system consists of a series of electrical heating elements housed in a metal tray and built into a ceiling panel.

Claimed advantages include in-built insulation, ready access to the ceiling void, and automatic regulation of heat for part or complete ceilings. [Ceilings Dept., Bowaters Sales Co. Ltd., 87 Kings Avenue, London, S.W.4. In Australia: Bowater Paper Co. Pty. Ltd., A.M.P. Building, Sydney Cove.]

Prevents Shoplifting

Shoplifting of radios, cameras and other small, expensive stock may be reduced by placing a small noise alarm device in each object. While an item is being examined, the alarm is silent. But if an attempt is made to carry it out of the shop, a short-range radio transmitter at the doorway activates the alarm and calls guards.

Detecttion Devices, Inc., of Hicksville, New York, U.S.A., sells the alarms for 75 cents each, with another 400 dollars for the transmitter at the doorway. The wafer-like alarm is small enough to be inconspicuous and when, for instance, a camera is sold it is removed by the shop assistant.

Electric Copyholder

An electric copyholder suitable for fitting to typewriters, accounting machines, teleprinters and linotype machines, advances the copy at the touch of a foot switch. The copy is turned up through rubber rollers either line by line or continuously.

The equipment, called the "Lindicator," is said to reduce strain and improve the accuracy of copying work. It has a silent, synchronous electric motor and the "carriage" is available in five sizes to take paper widths of 10½in, 18in, 24in, 30in and 36in.

A magnifying lens attachment is provided for reading very small print or bad handwriting. [Lindication Ltd., Mark Road, Hemel Hempstead, Hertfordshire, England. Australian Agents: Meares Bros. Pty. Ltd., H.O. 463 Swanston Street, Melbourne.]

Reduces Corrosion

Electrolytic Marine Services, of 1630 Store Street, Victoria, B.C., Canada, claims that its Cathelco process for the protection of sea-water-carrying pipes in ships not only reduces corrosion by as much as 85 per cent, but also completely eliminates the formation of marine growths in the pipes and suction chests.

The system, an electrolytic one, uses sacrificial anodes of a special type which are gradually corroded away instead of the pipes. The anodes are replaced annually.

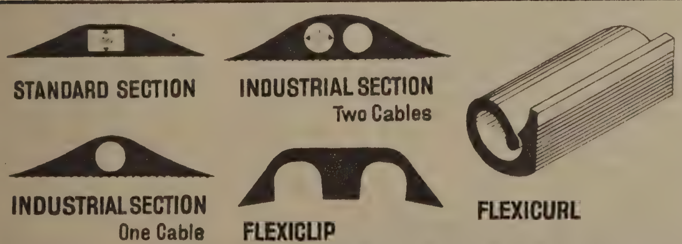
Pipe replacement costs of over 25 per cent of the total capital cost of the ship when new can be saved by using the process, claims the company. Cathodic and Electrolytic Engineers, of 81 Saltergate, Chesterfield, England, is handling sales in Britain and Europe.

Ultra-Fine Powder

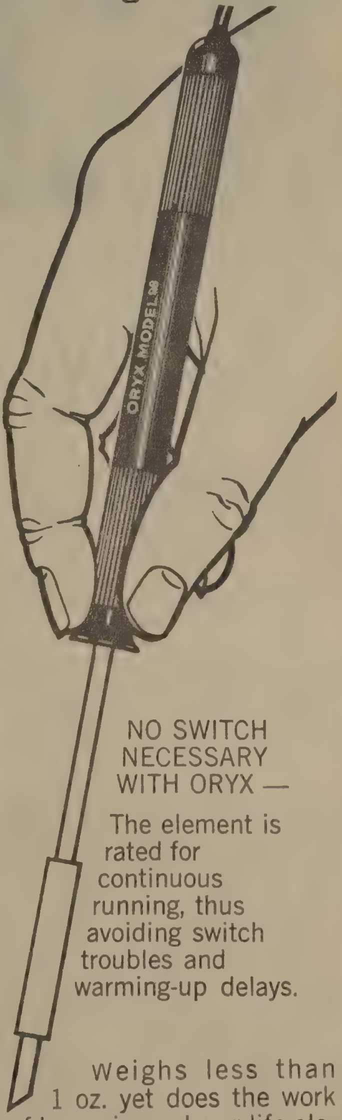
A method of making ultra-fine magnetic powder, which, when stuck on tape or used in instruments, permits sounds of very high frequency to be recorded, is reported by Nippon Electric Company, of 2, Shiba Mita Shikoku-Machi, Minato-ku, Tokyo.

The powder is obtained by vaporising a suitable alloy in an inert gas. The vaporised atoms collide with one another and coalesce to form the powder.

Of French design, this frequency selective voltmeter covers the range 30 to 15000cps, with a sensitivity from 100uV to 10V. It is fully transistorised and can be supplied with calibrations in decibels or nepers. (Laboratoire Electro-Acoustique, 5, Rue Jules Patent, Rueil Malmaison, France.)



Manufactured by Vulcascot Ltd., Acorn House, Victoria Road, London, the rubber conduit strip illustrated above is designed to reduce the hazard of cables lying loosely across factory floors. Some sections are designed to have leads threaded through them and to lie flat on the floor. Other sections can be attached to skirting, etc., and the leads clipped into them.



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NO SWITCH NECESSARY WITH ORYX —

The element is rated for continuous running, thus avoiding switch troubles and warming-up delays.

Weighs less than 1 oz. yet does the work of heavy irons. Long-life element and replaceable bits ensure years of service. There's an ORYX designed to meet your precise requirements.

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M.488

By
Keith
Jeffcoat

The only change in panel layout of our new receiver is the inclusion of an antenna tuning control under the antenna/converter switch.

The 1965 Amateur Band Ten

Here is a receiver which provides "amateur band only" reception on the major HF bands. The receiver uses the same chassis, front panel and, in fact, a goodly portion of the circuitry from our "Communications Eight" but a different front end tuning unit. Its construction should be just as easy as that of the "Communications Eight."

YOU may recall that the "Communications Eight" receiver was designed around a newly released Geloso general-coverage "front end" unit. As such, this receiver is capable of satisfying the demands of those with a general interest in the short wave bands. In fact, the receiver covers the full range from 550KC (the bottom end of the broadcast band) to 30MC (the upper limit of the high frequency bands).

Many amateur operators, however, have very little interest in general short-wave listening and the demands of some, at least, are better satisfied by a receiver which limits its coverage to those portions of the HF spectrum in which amateurs are licensed to operate.

To meet this demand Geloso made available, some years ago, a front end unit type 2620A. This is still a current type and is incorporated in our new version of the receiver. In fact, one of our motives in describing this version, is to meet the demand for such a set from amateurs who have had a Geloso unit "salted away," awaiting the opportunity to use it.

Physically, the unit is very similar to that used in the "Communications Eight" but, instead of providing general coverage on the HF bands, it covers the ranges 3.5 to 4.0, 7.0 to 7.3, 14.0 to 14.4, 21.0 to 21.5, 26.0 to 28.0 and 28.0 to 30.0 megacycles.

By "bandspreading" the ranges in this manner the receiver has much better frequency calibration. The amateur band receiver can be set to within 1KC of a given frequency, as against 20KC in the "Communications Eight," while the "tuning rate" of the receiver is vastly improved within the range covered.

With the growing use of SSB as a method of communication on the amateur bands, these two points are of great importance, particularly the latter one. The short-wave listener might have only a casual interest in SSB and may therefore be prepared to make do with the fairly coarse tuning rate, that usually goes with a wide coverage. Against this, the amateur, whose major interest might perhaps be in SSB, may demand a tuning rate which will obviate any difficulty in tuning in an SSB station.

Admittedly, it is possible to have a good tuning rate along with a wide general coverage but this can only be achieved with receivers of the "Deltahet" type and, for many, such a receiver is beyond their technical and economic reach.

A second approach, and one adopted by many amateurs, is the use of a general coverage receiver as a "tunable IF" into which is coupled a series of crystal-locked converters. This approach was covered in the last article on the "Communications Eight."

This approach does, however, still have some limitations in so far as the enthusiastic amateur is concerned.

To achieve the best bandspread and tuning rate the converter would, ideally, be arranged so that tuning of signals is done at, say, the middle of the broadcast band. This would give a first IF of approximately 1MC.

For signals on the 3.5 and 7MC amateur bands, an IF of this order would give an acceptable ratio of image rejection but for higher frequencies, say the 28.0MC amateur band, the image ratio would be rather poor by present-day standards.

The answer is to use a higher first IF and many amateurs do just this by taking 3.5 to 4MC as their tunable IF and crystal locking all of the higher amateur bands down to this frequency. The arrangement has the dual advantages of giving good image rejection and frequency stability of the received signal and, as an extra bonus, allows all of the amateur bands to be crystal locked with a single crystal if desired.

The disadvantage of this arrangement, however, is that we are almost back where we started from in terms of tuning rate. Most general coverage receivers would certainly have a better tuning rate at 3.5MC than they would at, say, 14MC but it would be nothing like the 20 to 1 improvement that can be achieved by spreading each amateur band over the entire dial face.

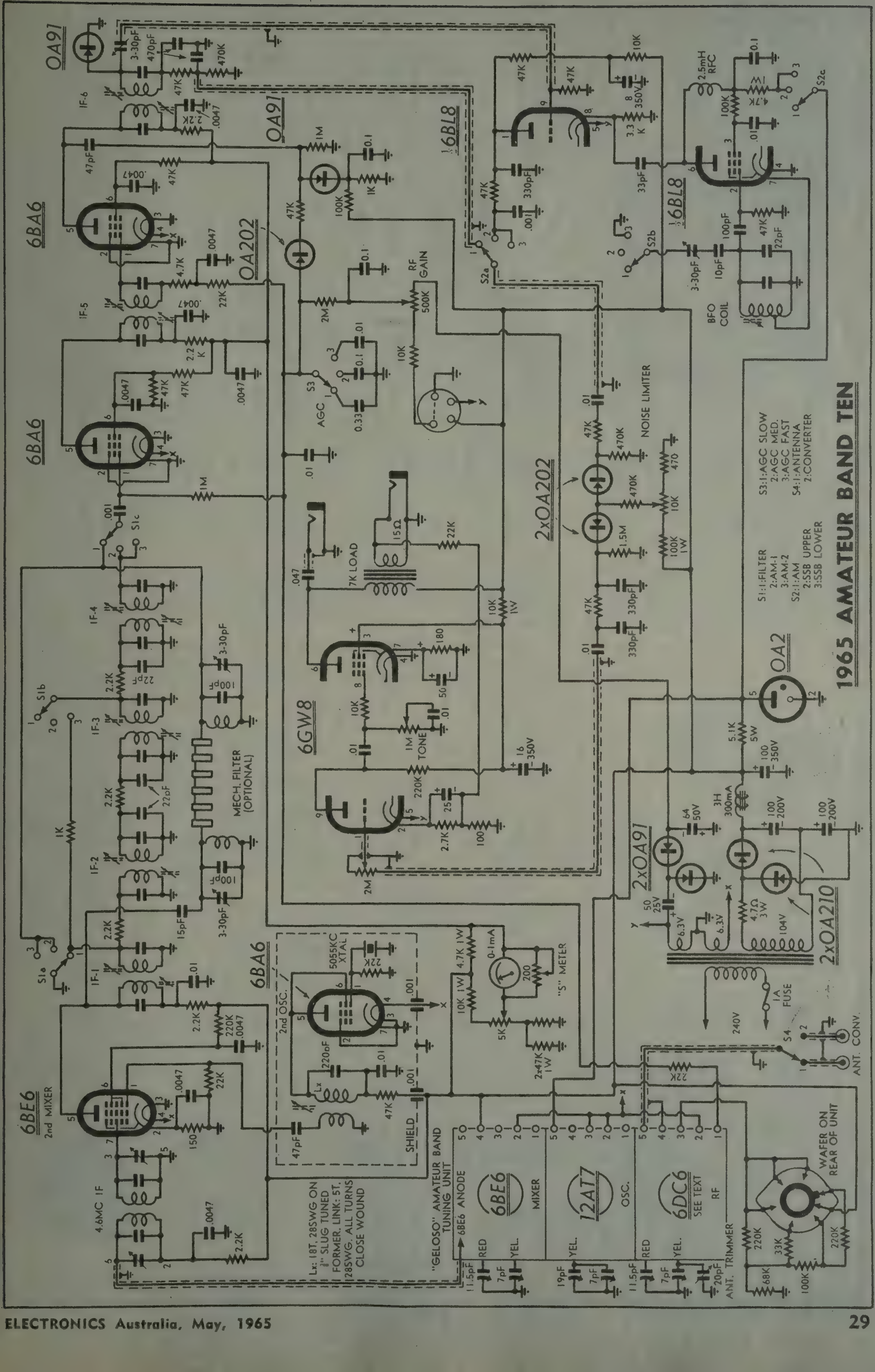
The Geloso unit solves all of these problems by its good bandspreading, as previously mentioned, and by bringing all signals to a first IF of 4.6MC, thus taking care of the image rejection problem. The kit is supplied complete with the first IF transformer at 4.6MC.

The front end has a tunable oscillator which runs on the high side of the signal frequency on each band. Thus, when receiving on 7.0MC the oscillator would be running at 11.6MC (7 plus 4.6MC). Good electrical stability is achieved by the use of high "Q" tuned circuits and careful capacitive temperature compensating in the oscillator section. This latter is made possible by the limited range covered on each band.

There are some changes in circuitry and valve complement of this amateur band front end, as compared with the unit used in the "Communications Eight." The first of these concerns the choice of a RF amplifier valve.

Geloso recommend the 6DC6 for this position. Unfortunately, we found this

Our main circuit diagram of the receiver shows the additions necessary to accommodate the new front end. We have also taken the opportunity to correct one or two small errors in what was basically the "Communications Eight" portion of the circuit.



1965 AMATEUR BAND TEN

S1: 1: FILTER
2: AM-1
3: AM-2
S2: 1: AM
2: SSB UPPER
3: SSB LOWER
S3: 1: AGC SLOW
2: AGC MED.
3: AGC FAST
S4: 1: ANTENNA
2: CONVERTER

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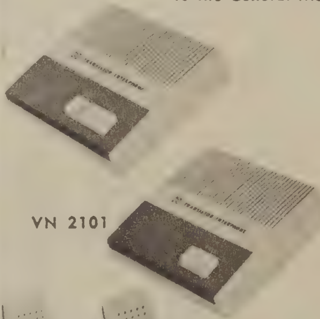
VN 2101

VL 290

MODEL	DESCRIPTION
VN2101	2 Station table type (illustrated)
VN2102	3 Station table type
TO101	Multiplex, master, 5 Stations
TO202	Multiplex, master, 10 Stations
TN701A	Slave unit
TP901	2 Station table set
VL290	2 Station standphone (illustrated)
VN1102S	2 Station door phone — hand phone

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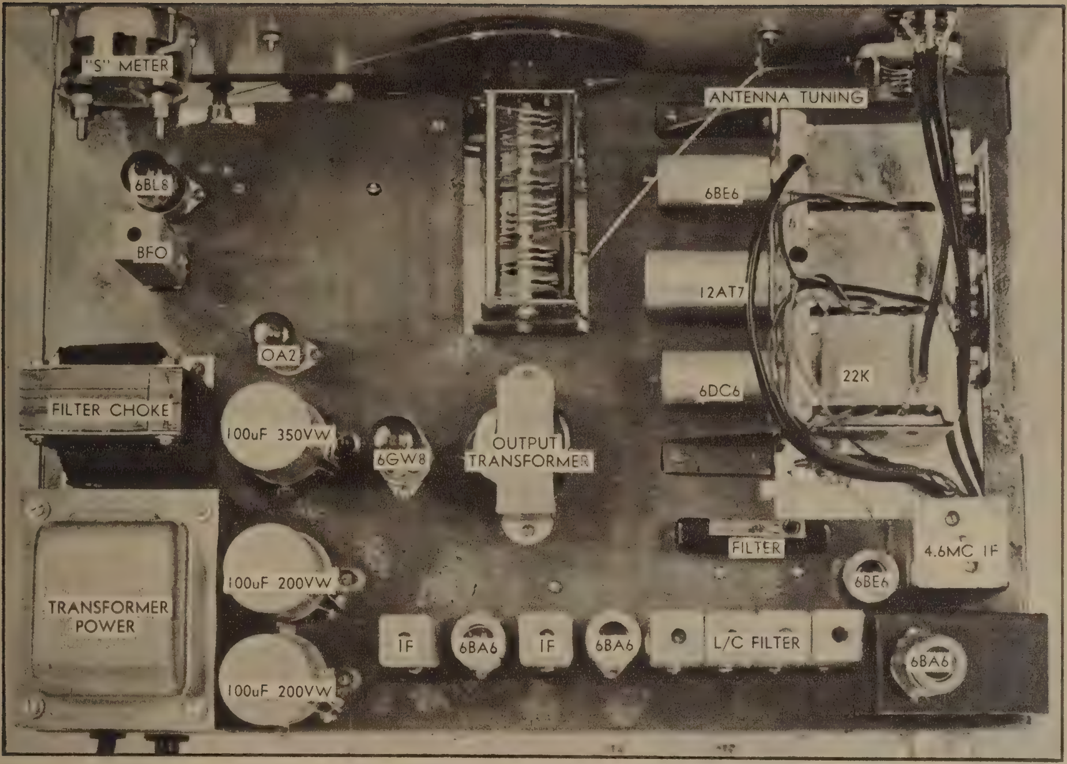

Our above chassis view of the unit shows clearly the layout of the new second mixer and its crystal locked oscillator. The rest of the layout is identical with that of the "Communications Eight."

valve almost impossible to procure and substituted type 6BZ6, a slightly higher gain valve of otherwise similar characteristics.

This valve requires a slightly different grid bias to the 6DC6 originally specified and, to take care of this, it is necessary to lift the side cover of the unit and replace the 150 ohm cathode resistor (pins 2 and 7 of the valve socket) with a 56 ohm resistor.

Readers who experience difficulty in obtaining both the 6DC6 and the 6BZ6 could use a type 6BA6 and, in this case, the cathode resistor can be omitted and pins 2 and 7 of the socket simply shorted to ground.

The oscillator valve is a 12AT7 twin triode in much the same circuit arrangement as the "Communications Eight." One triode acts as a tuned-grid inductive feedback oscillator; the second triode is a cathode follower buffer stage to prevent "pulling" of the oscillator by the mixer into which it feeds.

The tuning capacitor supplied with the kit is a specially made unit and the values of each section and the wiring of the sections, as shown on our circuit diagram, warrant some explanation.

The first point to be noted is that each section of the tuning gang actually consists of two separate tuning capacitors. On the aerial and RF stages and when covering the 3.5MC range the 11.5pF capacitor is connected in parallel with the 7pF unit to provide a total tuning capacitance of 18.5pF. On all other ranges the 11.5pF unit is out of circuit and only the 7pF capacitor is used for tuning.

The reason for this becomes apparent when we consider that, on 3.5MC, we have to effect a 12½ per cent change in frequency to cover the range whereas, on 14MC, we require less than 3 per cent change in frequency.

On the oscillator section of the unit the two sections of the tuning gang are permanetly wired in parallel to provide a 26pF capacitor. This may, perhaps, seem inconsistent with out earlier statement that the oscillator runs on the HIGH side of the signal frequency.

It is not inconsistent, however, because, in order to achieve a high "Q" in their oscillator circuits, Geloso have used a high capacitance-to-inductance ratio for the oscillator. The tuning capacitor on this section must, therefore have a much larger value if it is to yield the same frequency coverage as the capacitors on the aerial and RF sections, which have a high inductance-to-capacitance ratio.

Obviously enough, this whole arrangement allows the tuned circuits in each section of the front end to be optimised according to the part they play and is something that, in practice, is not possible in a general coverage receiver.

The switch shown immediately under the front end unit on our circuit diagram is used to change the value of the series screen feed resistor for the RF amplifier valve in the unit. This switch wafer is supplied and mounted on the rear of the front-end unit and it is only necessary to wire in the resistance values shown.

The purpose of the switch is to keep the gain of the front end relatively constant from band to band. The practical value of this is twofold; (a) it ensures that the "S" meter calibrations will be fairly constant, regardless of the band in use, and (b) it saves the listener from having to make a sudden dive for the gain control when changing bands.

Another minor change from the circuit of the "Communications Eight" front end is the inclusion of a panel-mounted "antenna trimmer" capacitor with this new unit. This capacitor is supplied with the kit and can be very conveniently mounted under the antenna/converter switch on the front panel.

The addition of this trimmer means that, regardless of the type of aerial used with the receiver, optimum adjustment of the first tuned circuit for best signal-to-noise ratio can be achieved.

The output signals from the mixer in the front end are fed to the special 4.6MC IF transformer supplied with the kit and this, in turn, feeds the second mixer, a 6BE6. We chose this valve for the job because it is more than adequate and, there being already one 6BE6 in the front end, it reduces the number of different valve types used in the receiver.

In our prototype of the receiver we used this 6BE6 as a combined mixer/oscillator by placing a crystal between its first and second grids in a simple "Pierce" oscillator circuit. We found, however, that this arrangement allowed some of the higher harmonics of the oscillator to leak through to the front end, where they appeared as spurious signals in the 3.5 and 7.0MC tuning ranges.

In an effort to overcome this problem we tried shielding the whole of the mixer/oscillator but the signal still found its way back to the front end at a strength too high to be acceptable.

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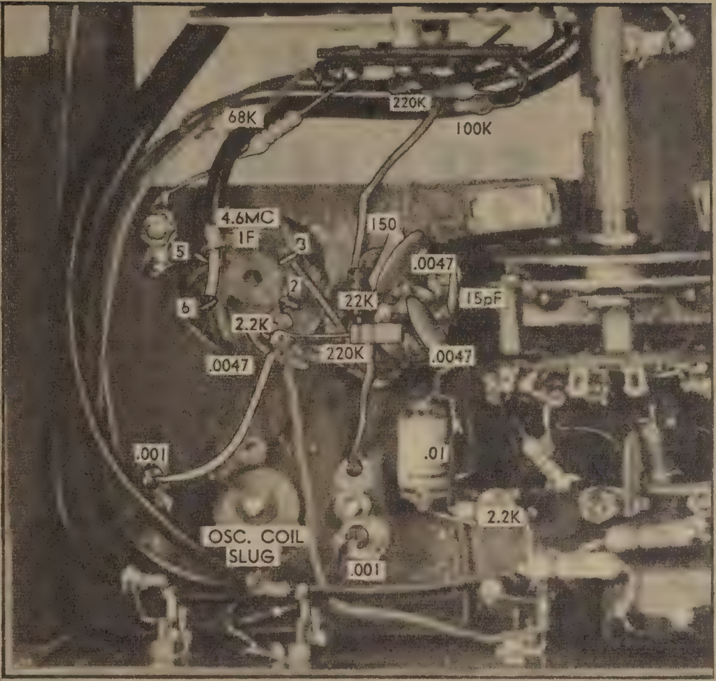
The final circuit adopted was a separate oscillator feeding the mixer and with the whole of the oscillator fully shielded in a small metal can. We used a 6BA6, triode connected as an oscillator valve, mainly in order, once again, to minimise the number of valve types in the receiver.

This arrangement of separate shielded oscillator and the particular type of oscillator circuit used keeps the spurious signals down to a level of about "S" 1 on the meter where they are quite tolerable. It is almost impossible to construct a double conversion superheterodyne receiver which does not have some spurious signals but, if they can be kept below the normal atmospheric and man-made noise level on the band concerned, they are not a source of trouble or irritation.

In the instruction sheet which Geloso supply with their front end they quote two crystal frequencies for use with the oscillator on the second mixer, one on the high side and one on the low side of the IF. DO NOT use crystals on these frequencies since they are designed to convert the 4.6MC first IF down to a second IF of 467KC. Our circuit, in keeping with Australian standards, demands a second IF of 455KC and the correct crystal frequency is 5055KC.

This crystal frequency is particularly important where a mechanical filter is to be used since the types of filter available in this country are all centred around 455KC and the IF must be adjusted to this frequency.



The only portion of the underchassis wiring which is different from the "Communications Eight" is that shown in this coded photograph of the bottom left hand corner of the chasss.

Many readers will realise that the crystal for the second conversion oscillator could also be run on the LOW side of the first IF and in this case the crystal frequency would be 4145KC. We do not recommend running a crystal on this frequency since it will create more spurious signals within the tuning range of the receiver than will the higher frequency crystal.

In their amateur band receiver designed around this front end, Geloso use both high and low side crystals and switch them into circuit in order to change sidebands on an SSB signal. We originally proposed to do the same thing but dropped the idea when we encountered the spurious signals from the lower frequency crystal. The "Communications Eight" changes sidebands by shifting the frequency of the BFO and we decided to retain this feature.

The output of the second mixer feeds into the switched L/C and mechanical filter at 455KC and this and in fact the rest of the receiver circuitry is identical with that of the "Communications Eight."

The operation and construction of this portion of the circuit was fully described in our previous articles (January, February and March, 1965) and we will not go into detail on it here. There are, however, a few points on the construction of the new front end and first mixer which might be worth mentioning.

The amateur band front end is exactly the same size and has mounting bolts in exactly the same positions as the general coverage unit and it will, therefore, drop straight into a chassis prepared according to the blueprints given for the "Communications Eight."

The bandswitch shaft on the amateur unit is, however, somewhat shorter than that of the general coverage unit and it will be necessary to extend it with a length of ¼in shaft and a coupling piece. Make sure the piece purchased is not longer than 5/8in or it will not fit between the front of the chassis and the front end mounting bracket.

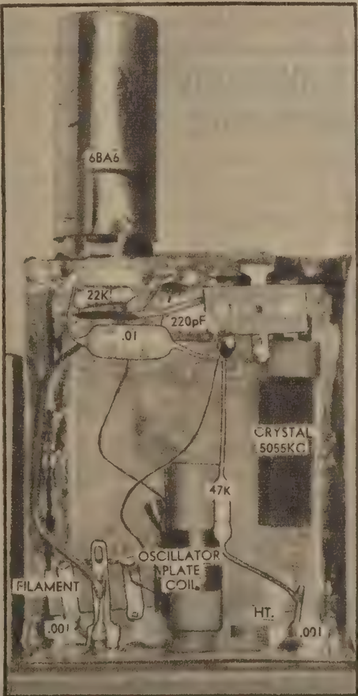
In mounting the front end unit take good care not to bump the slugs and trimmers mounted on the side of the unit. Remember the unit is factory pre-aligned and will need only a "touching up" once wired into the circuit PROVIDED the tuning adjustments have not been altered by rough handling.

The chassis blueprint prepared for this receiver shows holes for a valve socket and two crystals to mount in the immediate vicinity of the co-ax sockets at the rear of the chassis. These holes were originally intended for the crystal oscillator and its two crystals for changing sidebands, as mentioned earlier.

When we had to modify the crystal oscillator we simply built it in a separate metal case constructed from 20 gauge tinplate and mounted it above these holes. The holes are, in fact, made full use of to convey filament and HT voltages into the oscillator section and the slug of the oscillator plate coil is adjustable through the hole originally cut for the valve socket.

A drawing of the oscillator box, with all important dimensions, is included in the article. For the best results in the suppression of spurious radiation, we recommend that all sides of this box be soldered together along their full length. Do NOT rely on a couple of screws to hold the box together or it will leak RF like a sieve.

A close-up, coded photograph showing the location of components within the oscillator box is included in the



The wiring details of the inside of the oscillator box are shown in this illustration. The "hot" side of the crystal terminates on one lug of the tagstrip and the remaining insulated lug terminates the HT feed to the oscillator coil.

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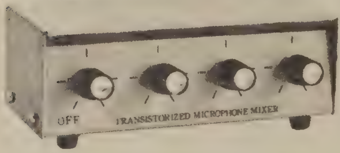

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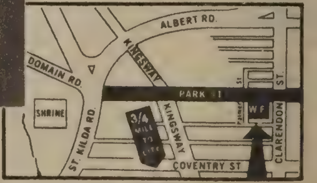

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article. No difficulties should be experienced if this layout is followed.

Note the use of 1000pF feedthrough capacitors on the filament and HT lines into the box. These are essential and the spurious signals will be increased by 12 to 15DB if either is omitted.

The oscillator plate is wound on a standard 3/8in diameter slug tuned former and consists of 18 turns of 28swg enamelled copper wire, close wound; the link winding consists of 5 turns of the same gauge wire wound near the "cold" end of the main winding.

Before wiring the connections to the tagstrips on the front end unit, it will be necessary to remove the shield plate from the top of the unit and solder one end of an 11in length of shielded wire to the plate (pin 5) of the 6BE6. The other end of this wire terminates on the plate connection of the 4.6MC IF transformer.

While this cover plate is removed alterations can be made to the cathode resistor of the RF amplifier valve to suit the particular valve to be used. Details of the resistor values are given at the start of the article.

Our article does not include a complete under-chassis view of the receiver, since most of the wiring is identical with that of the "Communications Eight" and readers can refer back to the January, 1965, issue for these details.

We have, instead, shown a close-up of the underchassis wiring of the 6BE6 first mixer and the switch wafer at the rear of the Geloso unit. This portion of the wiring is the only part which differs from the earlier receiver and our coded view of it should enable construction to be completed with a minimum of difficulty.

Those who would like a "wire by wire" description of the receiver wiring from the 455KC filters through to the output stage can refer to the February and March, 1965, issues.

The alignment of the receiver—front end, filters and BFO—is fully covered in the March, 1965, issue and details will not be repeated here. Because of the precise frequency calibrations and limited coverage of this front end it will not be possible to adjust the oscillator tracking with a simple signal generator. The minimum requirement would be a frequency meter of the Bendix type or, at the very least, a 100KC crystal standard to establish reference points.

The feature of switched converter inputs is retained in this receiver and those who wish to use VHF converters with the unit should crystal lock them to be tuned in the range 26 to 30MC. For this tuneable IF a 144MC converter would require a crystal on 6333KC (3rd overtone oscillator with its output multiplied by 6) and for 50MC an 8MC crystal in a 3rd overtone oscillator circuit could be used.

Because the first IF in this receiver is within the international short wave bands (4.6MC) there is the possibility that signals on this frequency may pass from the aerial through the front end to the first IF when they would be tuned and converted to 455KC ultimately to appear in the output of the receiver. We note, in fact, that Radio Nepal has a 5 kilowatt transmitter on this frequency.

Those who experience difficulty in this regard can easily overcome their problem by constructng a 4.6MC trap consisting of a simple parallel tuned circuit and placing it in series with the antenna connection to the front end.

This trap could consist of 3/8in diameter slug tuned former with 18 turns of 28 swg enamelled copper wire wound on it (close spaced) and with a 220pF capacitor in parallel with the coil.

COMPLETE LIST OF PARTS

Geloso amateur band front end unit type 2620-A

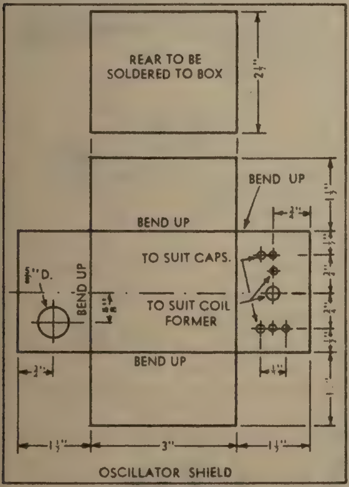
- 1 Power transformer — pri. 240 volts, sec. 104 volts (voltage doubler type) at 150 milliamps DC, plus two 6.3V at 3A heater windings.
- 1 Filter choke — 3 henries at 300 milliamps.
- 1 Output transformer — 7000-ohm primary, 15-ohm secondary.
- 6 IF transformers — medium gain, medium selectivity 455KC. (100pF across windings).
- 5 7-pin valve sockets.
- 2 9-pin valve sockets.
- 2 100uF — 200 volts working "can" type capacitors.
- 1 100uF—350 volts working "can" type capacitor.
- 1 BFO coil, 455KC—Hartley oscillator type (single winding with tap near bottom).
- 1 Suitable meter, 0-1mA, 2½ by 2½ inches, calibrated in "S" units as per our diagram.
- 3 6BA6 valves.
- 2 6BE6 valves.
- 1 12AT7 valve.
- 1 6BL8 valve.
- 1 6GW8 valve,
- 1 6DC6 valve (see text).
- 1 OA2 valve.
- 1 2-pole, 2-position switch.
- 1 single-pole, 3-position switch.
- 2 3-pole, 3-position switches.
- 1 0.5 megohm potentiometer.
- 1 1 megohm potentiometer.
- 1 2 megohm potentiometer.
- 1 10K ohm potentiometer.
- 1 5K ohm wire-wound potentiometer.
- 1 200 ohm wire-wound potentiometer.
- 2 Co-axial sockets.
- 2 4-pin speaker type sockets.
- 2 Phone jack sockets (non-shorting type).
- 1 Fuse holder.
- 1 455KC mechanical filter (optional).
- 3 2-lug tagstrips.
- 7 3-lug tagstrips.
- 2 4-lug tagstrips.
- 5 5-lug tagstrips.
- 1 10-lug tagstrip.
- 3 ⅜in grommets.
- 10 Suitable knobs.
- 1 ¼in shaft bearing.
- 12 Solder lugs.
- 1 Chassis and front panel (blueprints available through our query service).
- 6 dozen ⅛in whitworth nuts and 4 dozen ⅛in by ⅜in bolts.

RESISTORS

- 1 4.7 ohm 5W
- 1 100 ohm ½W
- 1 150 ohm
- 1 180 ohm 1W.
- 1 470 ohm ½W
- 5 1000 ohm ½W
- 4 2.2K ½W
- 1 2.7K ½W
- 1 3.3K ½W
- 1 4.7K ½W
- 2 4.7K 1W
- 1 5.1K 5W
- 3 10K ½W
- 2 10K 1W
- 5 22K ½W
- 10 47K ½W
- 13 47K 1W
- 1 68K ½W
- 14 100K ½W
- 1 100K 1W
- 4 220K ½W
- 3 470K ½W
- 2 1.0M ½W
- 1 1.5M ½W
- 1 2.2M ½W

CAPACITORS

- 1 10pF ceramic NPO.
- 2 22pF ceramic NPO.
- 1 33pF ceramic NPO.
- 4 3/30 pF compression trimmers.
- 6 47pF ceramic NPO.
- 3 100pF plastic.
- 1 220pF plastic.
- 3 330pF plastic.
- 2 470pF plastic.
- 2 .001 uF plastic.
- 2 .001 ceramic feedthrough.
- 1 .0022uF ceramic.
- 7 .0047uF plastic 400V.
- 9 .01uF plastic 400V.
- 1 .047uF plastic 400V.
- 4 0.1uF plastic 400V.
- 1 0.33uF plastic 125V.
- 1 8uF 350V electrolytic.
- 1 16uF 350V electrolytic.
- 1 25uF 25V electrolytic.
- 2 50uF 25V electrolytics.
- 1 64uF 50V electrolytic.
- 4 OA91 (or similar type) diodes.
- 3 OA202 (or similar type) diodes.
- 2 OA210 (or similar type) diodes,
- 1 2.5 millihenry RFC.
- 1 5055KC crystal.
- 1 Crystal socket.
- 1 4pin plug (to match rear of chassis sockets).
- 1 3-pin power plug.
- 6 feet of 3-core power flex.
- 5 yards of shielded wire.
- 1 yard 18-gauge tinned copper wire.
- 10 yards of hookup wire (several colours).



The oscillator shielded case should not be made larger than the dimensions on our drawing or the valve will foul the top of the receiver case.

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DC Current: 0-10, 0-250 mA.

Resistance: Ranges	Centre Scale
0-20,000 Ohms	200 Ohms
0-2Megs.	20,000 Ohms

Decibels:—20—22dB. 20-36dB. (0db 1mW into 600 Ohms).
Dimensions: 3¼" x 4¾" x 1¾".
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Printed circuit.
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AC Voltages: 0-3-12-30-120-300-600-1,200 V at 13,000 Ohms per volt.
DC Current: 0-.06-6-60-600 mA, 0-12 A.
Resistance: 0-60K-6M-60M (350, 35K, 350K at mid-scale).
Decibels: minus 20 to plus 57 dB (O dB equals 1 mW. 600 ohms).
Audio Out: Capacitor in series with AC volt ranges.
Short Test: Internal buzzer.
Accessory: 1 pr. heavy test leads.

Price £15/10/-

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Batteries: 1 (1.5V), 1 (15V).
Size: 3 5-16" x 6 5-16" x 2¾"
Weight: 1.4lb approx.

LIMITED STOCK ONLY

Model RH-10

RANGES:

DC Voltages: 0-10-50-500-1,000 V at 2,000 Ohms V.
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DC Current: 0-500uA 0-500 mA.
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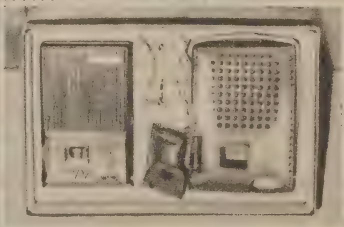

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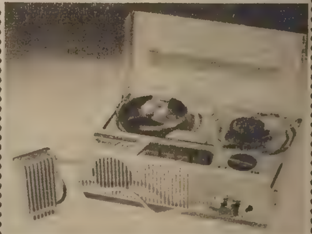

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FIXED CAPACITORS

a guide to types and characteristics

This article should provide very useful parallel reading to the Basic Radio Course, which has been running for almost two years. The writer discusses here the types and the characteristics of fixed capacitors in current use.

By P. S. Redfearn

THE type of dielectric that a capacitor employs is perhaps its most important feature, and it provides a logical basis for the general classification of capacitors. The most commonly used dielectrics are:—

impregnated paper,
mica,
oxide film (electrolytic),
ceramics,
plastic film.

Before proceeding to discuss these five categories, it will be an advantage to first consider the main characteristics of capacitors—tolerance, i.e. accuracy; stability; voltage rating; leakage losses; and operating frequency.

The tolerance of a capacitor is expressed as a percentage and represents the degree of accuracy that has been achieved in the production of a component of a stated value; the accuracy might be achieved by manufacturing techniques, by adjustment subsequent to manufacture, or by selection.

The closest tolerance that is normally called for in circuit design is ± 1 per cent and the widest −50/+100 per cent. What is actually used between these two extremes depends on application and cost. Since close tolerance components are the more expensive, it is logical to specify them only for those circuit applications where they are necessary.

The stability of a capacitor is its ability to maintain its characteristics, notably capacitance value, with the passage of time and under varying conditions; there is little to be gained in selecting a component having a tolerance of ± 1 per cent if it is going to change by a greater amount every time the weather becomes warmer or the humidity increases. As might be expected, types of capacitor which are inherently unstable, in this sense, are not usually available with close tolerances.

Changes of value might be cyclic or non-cyclic; in other words, there might or might not be a reversion to the original value when the cause of the change is removed.

Depending on the type of capacitor and the environment in which it is used or stored, a non-cyclic change usually occurs with age, while a cyclic change arises from variations in temperature during operation. The change of value with temperature might be negative (increased temperature causing reduced capacitance) or it might be positive (increased temperature causing increased capacitance) and it might or might not be a linear relationship.

In some types the change is subject to control and is consistent while, in others, it is indeterminate and varies greatly from sample to sample.

Where the relationship between change of capacitance and change of temperature is reasonably linear and consistent, a temperature coefficient is specified in parts per million per degree centigrade (ppm/°C). The coefficient figure is generally preceded by either a "P" or the positive sign (+) to indicate a positive coefficient, or an "N" or the negative sign (—) for a negative one; components that have a nominally zero coefficient are usually indicated by "NPO." (There is provision in the standard colour code for indicating the coefficient on the capacitor itself, by means of a dot or band.)

By way of example, a typical polystyrene capacitor has a coefficient of −150ppm/°C, while an electrolytic might be +2000ppm/°C. Other causes, perhaps less commonly known, which give rise to changes of value are the frequency and magnitude of the voltage applied to a capacitor.

The **operating frequency** must always be considered when selecting a capacitor for a particular application, because most types only function satisfactorily over a limited frequency range. This is essentially due to the properties of the various dielectrics and the fact that every capacitor possesses some inductance. There are dielectrics which introduce large losses at high frequencies and others which alter in their behaviour at low frequencies, while there are some that suffer from variation of permittivity at different frequencies and thereby cause the capacitance value to change.

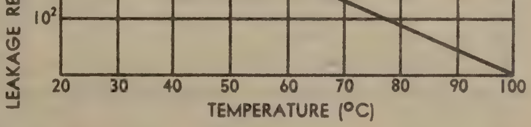

Figure 1: Illustrating the relationship between leakage resistance and temperature for two types of capacitor.

In equipment developing appreciable power at high frequencies, the use of a capacitor having a high-loss dielectric could endanger the equipment, apart from impairing its performance, because heat generated within the component could destroy it.

The influence excited by the self-inductance of a capacitor depends, as might be expected, on its own characteristics, its circuit function and on the operating frequency.

There must always be some frequency at which the self-inductance and capacitance resonate and beyond which the component behaves more like a choke, but without any DC path. For example, a 0.1uF impregnated paper capacitor used for decoupling purposes at medium frequencies would be virtually useless in a similar role at 100MC, where a ceramic type as small as 100pF would be appropriate.

Some capacitors designed for use at high frequencies have extremely low values of self-inductance and it is important to remember that the inductance of the connecting leads can be appreciable by comparison.

Leakage is one aspect of a capacitor that is most familiar to servicemen! In this respect some types of dielectric are better than others but, for a given type, the leakage resistance is always inversely proportional to the capacitance and is generally expressed in megohm-microfarads.

Thus, if the leakage resistance of a given type of component is stated to be 1000 megohm-microfarads, then a 10uF sample will have a leakage resistance of 100 megohms. The value of resistance is greatly influenced by temperature, and this is illustrated by the accompanying graph. It is apparent that the silvered mica capacitor is less susceptible to temperature changes than the metallised paper type.

Some dielectrics absorb moisture, even in temperate climates, and in a tropical enviroment the moisture absorbed might be a considerable amount. Components which have lost their protective coating or have cracked cases or are otherwise physically damaged should be treated with great suspicion.

The voltage rating of a capacitor as stated by the manufacturer only applies under specified conditions, including temperature, operating frequency, etc. The voltage ratings of all capacitors are reduced when they are used at elevated temperatures, but the extent of the derating depends on the type of capacitor. Any moisture absorbed by the dielectric will also adversely affect the voltage rating.

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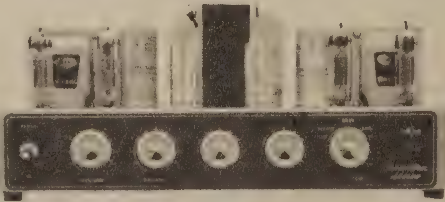

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to transient voltages or surges in excess of their rating and, whilst most of them withstand the excess for a limited period, the extent to which they can do so varies between different types and the circuit conditions.

Dielectric breakdown can occur in two ways; it can be sudden and catastrophic, as when an electrolytic erupts and discharges its messy contents, or it can be a gradual breakdown over a long period of time culminating in total failure. Many dielectrics deteriorate with age, especially when operated outside their correct ratings.

When selecting a capacitor for use where the applied voltage is alternating it is quite inadequate to select on the basis that the DC rating is equal to the peak value, because the characteristics of many dielectrics change when subjected to an alternating stress, to an extent which depends on the magnitude and frequency of the applied voltage. Under such conditions, the dielectric deteriorates and the loss resistance increases, thus causing increased internal heating; as a result, the dielectric properties deteriorate even further.

The fact that the reactance of a capacitor is inversely proportional to frequency gives rise to another difficulty; for a given applied voltage the current through a capacitor and the heat developed increases with increasing frequency. It is seen, therefore, that the working voltage of capacitors in AC circuits depends on a number of factors which cannot accurately be deduced from their DC ratings.

When there is any doubt about the AC rating of a component it is wise to consult the manufacturer's literature. The derating curves for two impregnated paper capacitors, with an alternating voltage applied, are shown. In the case of the larger component, note how rapidly the permissible applied voltage decreases between zero (or DC) and 600cps.

CAPACITOR LOSSES

The last aspect of capacitor performance to be considered is that of losses which consist of the resistance of the metal forming the electrodes, connecting leads and the junction of the two; in addition the dielectric introduces losses and these are dependent on the nature of the material itself.

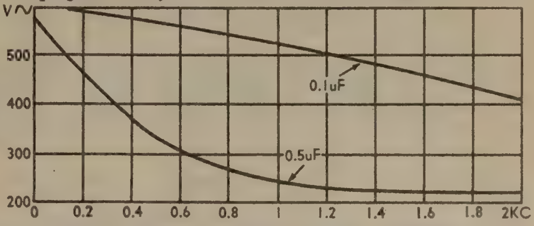
It is generally convenient to lump together all the losses and to represent the sum as a resistor connected in series with the capacitor; the "goodness" (or "lossiness") can then be expressed as a value of Q, being the ratio of pure reactance to loss resistance. Any value of Q is only applicable at one particular frequency and, again, it can vary according to the conditions under which the capacitor is used.

A few manufacturers state, in their literature, the Q values for certain types of small capacitors, at different frequencies, whilst others state the power-factors, usually for the large capacitors only. In the latter case, it should be remembered that the Q is equal to the reciprocal of the power-factor. Perhaps the best example of making use of capacitor Q values is in the design of a tuned circuit where it would obviously be senseless to achieve a Q of 200 in a coil and then tune it with a capacitor having a Q of 30!

IMPREGNATED PAPER CAPACITORS. As the name implies, this type of capacitor employs a paper dielectric to interleave aluminium foil electrodes; the paper is impregnated with an oil, wax, or jelly, each of which can effect the performance of the capacitor, mainly by the somewhat inevitable absorption of moisture which is then held in suspension.

Furthermore, the impregnant may evaporate in course of time; i.e. the capacitor "dries out." The rate at which this occurs depends on the type of dielectric, the outer protection of the capacitor, and the conditions under which it is used.

Figure 2: A typical curve showing how the AC voltage rating for paper capacitors diminishes with rising frequency.



The outer protection is, therefore, of paramount importance since it acts as a barrier against the ingress of moisture and evaporation of impregnant. The time-honoured waxed cardboard tube does not give adequate protection, even in temperate climates, for any but the least critical applications, such as decoupling low resistance circuits.

Better protection is afforded by the plastic-coated cardboard tube and the moulded plastic case but even these fail if the bond between the plastic and the connecting lead is inadequate, or when the plastic case cracks, as some of them do. The best protection, though not infallible, is provided by a metal outer tube with the ends sealed by neoprene or rubber bungs; this is satisfactory, even in tropical climates.

The leakage resistance of impregnated paper capacitors might initially be of the order of 25,000meg-uF for the metal tube type and 1000meg-uF for the waxed cardboard tube type. However, in use and during storage the figure can fall considerably to a few meg-uF for the cardboard type.

When the temperature is increased beyond room temperature (about 18°C) the leakage resistance, maximum working voltage and Q all deteriorate rapidly, and it is possible for the leakage to increase ten-fold for a two-fold increase of temperature. These capacitors are manufactured with a range of values from .001uF to several uF, having tolerances of ±20 per cent or ±10 per cent and a temperature coefficient between +100 and +200 ppm/°C.

A development of the impregnated paper capacitor is the **metallized paper** type which has the electrodes deposited

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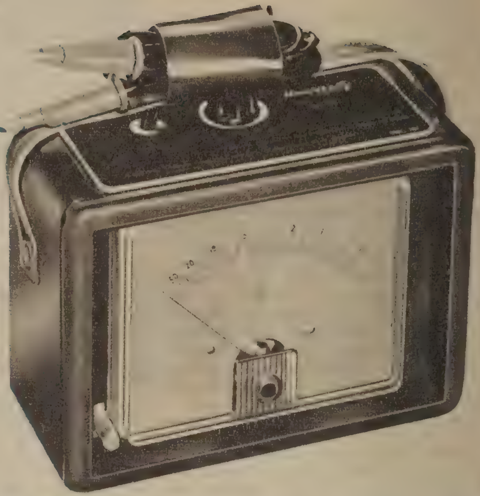

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onto the paper, but is otherwise similarly constructed and has similar characteristics. For a given value, the metallized component is smaller, less inductive but has a lower leakage resistance* than its counterpart. It has been used extensively for decoupling purposes at frequencies up to 100MC. (*See figure 1.)

This capacitor is claimed to have self-healing properties following a breakdown, by virtue of the fact that the aluminium metallising is rapidly burnt away around any puncture in the paper; hence the spark does not last long enough to carbonise the paper and so bridge the gap.

A disadvantage of this mechanism, however, is that where the circuit resistance is too high the spark is extinguished too quickly, so that insufficient metallising is burnt away and the capacitor becomes leaky as a result.

MICA CAPACITORS. These capacitors have excellent characteristics and are widely used wherever stability, accuracy, low losses and high leakage resistance are important. The dielectric properties of mica are greatly affected by moisture and the performance of a capacitor is a measure of the effectiveness of its outer protection.

Wax and lacquer dipped finishes are perhaps the most common, but they are now being superseded by cement and plastic dipped types which are satisfactory over a much wider range of humidity and temperature. Moulded synthetic resin is another type of finish and is the best for the most critical applications.

A capacitance range from a few picofarads to 10,000uF is commonly available, but the inductance of the electrodes of the larger values preclude their use at very high frequencies, while their size and cost might make them unacceptable even at lower frequencies.

So far, what has been said applies generally to the three types of mica capacitor in current use—silvered mica, plain mica, and stacked foil—although their characteristics vary in other respects.

Silvered mica capacitors are readily available with a tolerance of ±1 per cent and a temperature coefficient in the range ±60ppm/°C; their long-term stability is very high and, providing their outer protection is efficient, a Q value between 300 and 1000 and a leakage resistance above 1000meg-uF are commonly achieved.

Stacked foil and plain mica capacitors have inherently poorer accuracy and stability but, because of the nature of their construction they can sustain a larger current than the silvered mica types. Their temperature coefficient lies in the range ±200ppm/°C.

(Note the ± sign for temperature coefficients. Mica has a near-zero coefficient but the form of construction and nature of coating material may give it either a + or − characteristic. Data sheets give the appropriate sign for individual types.)

CERAMIC CAPACITORS. Of all the many kinds of capacitors that are manufactured, none perhaps are produced in a greater variety of forms (both electrical and physical) than the ceramic; this would seem to be a fair indication of the usefulness of this type of capacitor and the extent to which it has been developed.

The properties of ceramic dielectrics differ according to the mixture of earths and other additives from which the ceramics are made; the final products can be broadly classified as the following types:—

1. high permittivity.
2. medium permittivity (temperature compensating).
3. low-permittivity (low-loss).
4. high working voltage.

Barium titanate is the basic ingredient of high-permittivity ceramic and permittivities of the order of 5000 are possible, enabling components of small size and low inductance to be made. Unfortunately, the Q and stability are rather poor and the losses increase markedly with increasing alternating voltage.

A common tolerance is −20/+100 per cent and about the best is ±20 per cent. A temperature coefficient for these hi-K types is rarely specified because it is so dependent on the applied voltage. They are produced in a capacitance range of about 100pF to .01uF, and in the form of a tube, disc, wedge (for printed boards) and feedthrough; the usual DC working voltages are 350, 400 and 500.

Their main application is that of decoupling in HF and VHF circuits where their small size and good high-frequency performance make them ideal for the purpose. High-permittivity ceramic is also used in the manufacture of capacitors with values up to 1.0uF and working voltages between 3 and 30. They have, in fact, a somewhat better Q than the higher voltage types. As might be deduced, they are primarily intended for use with transistors.

A medium-permittivity dielectric is commonly a ceramic compounded to exhibit a specified temperature coefficient and, in the course of time, most manufacturers have agreed to produce standard values. These are +100, ±0, −30, −80, −150, −220, −330, −470 and −750ppm/°C; the tolerances on these varying between ±30ppm/°C for nominal +100 to −150 types and ±120ppm/°C for nominal −220 to −750 types.

The capacitance range is from 0.5pF to a few hundred pF with tolerances of 5 per cent, 10 per cent and 20 per cent. The Q averages about 1000 and the leakage resistance is of the order of 10,000 meg-uF. These temperature-compensating capacitators are produced in similar physical forms to the high-permittivity type, though by far the most common is the tubular construction.

Their main application is in tuned circuits where they might constitute the whole, or part, of the tuning capacitance, in order to compensate for the temperature coefficient of associated components.

Capacitors made of low-permittivity dielectric material are similar in all respects to the medium-permittivity types except for the temperature coefficient which is about +100ppm/°C. They are widely used in tuned circuits (where temperature compensation is not required), IF couplings, etc., and are satisfactory at frequencies up to 700MC or so.

High working voltage ceramic-dielectric capacitors are available for DC, AC, or pulse working, and are to be found in mains isolating and interference suppression circuits and television receiver timebases, particularly the line output stage. As might be expected, these capacitors are somewhat larger in size than the types previously described and are invariably of disc or tubular construction. They are produced in a wide range of working voltages, from 250V AC to about 25KV pulse.

OXIDE FILM (ELECTROLYTIC) CAPACITORS. This type of capacitor has a dielectric which consists of an oxide film formed on one electrode by means of electrolytic action and, in accordance with the laws of electrolysis, this electrode must serve as the positive electrode in actual use.

Electrolytic capacitors nowadays are of the so-called "dry" type which are comprised of aluminium foils separated by electrolyte-soaked cloth or paper, wound into cylindrical form, and housed in either a metal, cardboard, plastic or ceramic tube. The positive electrode is usually etched by chemical means in order to increase its effective area and thus provide a higher capacitance-to-volume ratio than is possible with a plain foil.

Electrolytic capacitors are neither very accurate nor very stable; a typical tolerance is −20+100 per cent and the temperature coefficient will generally be between +1000 and +2000ppm/°C. Q values lie between about 20 and 50 for a component in good condition. The leakage resistance depends upon the ratio of the applied working voltage to the voltage used in forming the film during manufacture and it is affected by temperature and the conditions of use.

It is more convenient to measure the leakage resistance in terms of leakage current at the working voltage, rather than in terms of megohm-microfarads, and typical maximum current (uA) values for a range of fully-formed capacitors, measured at room temperature, are shown in the accompanying table.

	LEAKAGE CURRENT IN MICROAMPS					
V wkg.	8uF	16uF	32uF	50uF	100uF	500uF
25	30	45	65	80	110	250
50	65	90	120	160	220	500
150	200	270	400	500	650	1500
250	300	450	650	800	1100	2500
350	450	650	900	1100	1600	3500
450	600	800	1100	1500	2000	4500

Capacitors that are out of use for protracted periods suffer a deterioration of the dielectric, giving rise to unduly high leakage current when they are eventually put into service; this applies equally to components on the shelf and to those fitted in equipments which have been inoperative for some time.

Where the circuit resistance is sufficient to limit the leakage current to a safe value the oxide film will re-form within a few minutes, depending on the temperature at which the capacitor has been stored and the time it has been out of use. Where the circuit resistance is low, however, the leakage current

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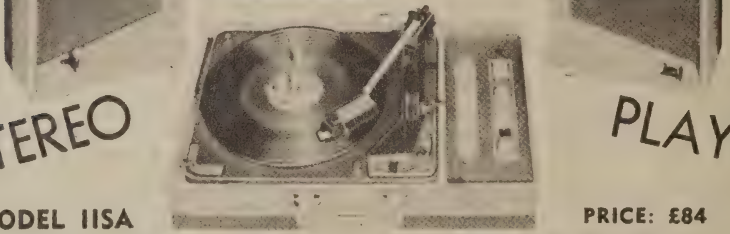

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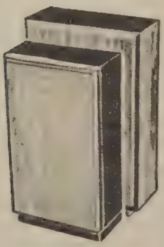

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might be excessive and cause the capacitor to overheat and be either damaged or destroyed.

In order to prevent this the capacitor should be re-formed under controlled conditions. On all capacitors there is indicated the DC working voltage and, in addition, there may be shown either one or two other ratings—surge voltage and ripple current.

The surge voltage is the highest possible DC voltage that a capacitor can tolerate for a very limited period as, for example, in a power supply employing a directly heated rectifier or a metal rectifier when, after first switching-on, there is a time-lag before the load takes its full current.

The ripple current rating is of primary interest when a capacitor is used as a reservoir where the alternating voltage superimposed on the direct voltage is appreciable and the component therefore, must handle considerable alternating current.

Because the Q is poor, this current generates heat in the loss resistance; for that reason, many capacitors specifically designed for use as reservoirs have a plain foil and tend to be larger than average in order to dissipate heat better. Multi-section capacitors invariably have the reservoir section outermost and in proximity to the container.

PLASTIC - FILM CAPACITORS. These employ a dielectric film of either polystyrene or polyethylene-tetraphthalate (polyester).

The polystyrene types have properties rather similar to those of mica capacitors but are made in a similar form to the impregnated paper component. They are available in tolerances down to ±1 per cent and have a long-term stability of about 0.25 per cent. Their temperature coefficient is about —120 to —150ppm/°C and, where such a coefficient is appropriate, they can be used to advantage in place of ceramic capacitors for compensating purposes.

A Q of about 2,000 is quite common and the leakage resistance can be as high as 1,000,000 megohms. The DC working voltage ratings available are from about 100V to 2KV and AC ratings from 250V to 1KV. The low-capacitance, low-voltage (DC) components can be very small physically and such types are extensively used for tuning miniature IF and oscillator transformers in transistor radio receivers.

SPECIALISED TYPES

Capacitors in the range .005uF to 0.5uF (about the largest value currently manufactured) tend to be rather bulky, particularly in the higher voltage ranges; because of this, and the fact that they are costly, their use is restricted, at the present time, largely to the more critical circuit applications or to equipment where cost is secondary to reliability.

Polyester capacitors are produced in lacquer-dipped tubular and rectangular forms and in plastic-moulded rectangular form. Their general characteristics and range of application are closer to the impregnated paper type, and electrodes might likewise be either foil or metallising.

Capacitance values from .001uF to 1uF are readily available with tolerances of ±10 per cent or ±20 per cent; common DC working voltages are 30V, 125V, 250V and 400V. The average leakage resistance of polyester capacitors is 15000 meg-uF, subject to a maximum of about 50000M for the foil electrode type and about 25000M for the metallised type. Their leakage resistance falls slightly with increasing temperature, but it is not necessary to de-rate the working voltage until 80°C is exceeded!

Temperature coefficient varies to some extent with temperature, the average being about +300 ppm/°C at 18°C, and the long-term stability is considred to be 5 per cent. Q values range between 140 and 200 at 1KC to less than 100 at 1MC: consequently, the main application of these capacitors is in AF and DC circuits, except in circumstances where the low Q is acceptable at higher frequencies.

CONCLUSION: The technology of capacitor manufacture is constantly advancing and what has been stated here concerning the properties of some of the capacitors might already be out-of-date. Fortunately, this generally affects only the design and research departments of large concerns who can afford (sometimes!) to avail themselves of the very latest improvements and new components.

For the rest of us there is often a long delay before production techniques, coupled with demand, bring down the price of a new item sufficiently to justify its use. There are two comparitively recent developments which illustrate the point — tantalum-foil electrolytics and the so-called "all-glass" capacitor (naturally, the electrodes are metal but both the dielectric and the outer protection are glass.)

GREATER COST

Tantalum electrolytics are similar to the aluminium types in some respects, but employ a different electrolyte; they are also smaller in size for a given value, more accurate and stable, and have a much lower leakage current.

Five years ago they were difficult to procure, while today they can be purchased readily though at a price which is about twenty times greater than an aluminium type of comparable value and voltage rating.

The all-glass capacitor is still at the stage where the only justification for its cost is its use in artificial satellites. One day, these two components will be as commonplace as most of their forerunners are now, and the radio man will instead cast envious eyes at yet more novel products, as the manufacturers strive for their ultimate goal of the ideal capacitor. ◘

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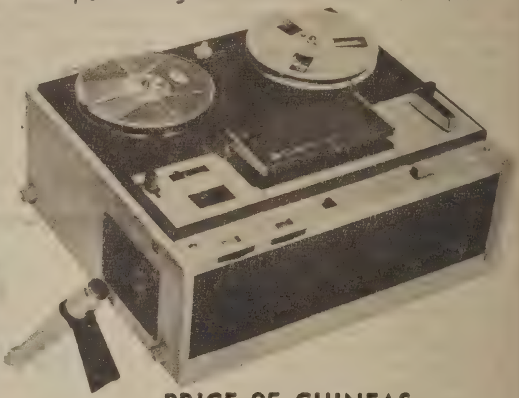

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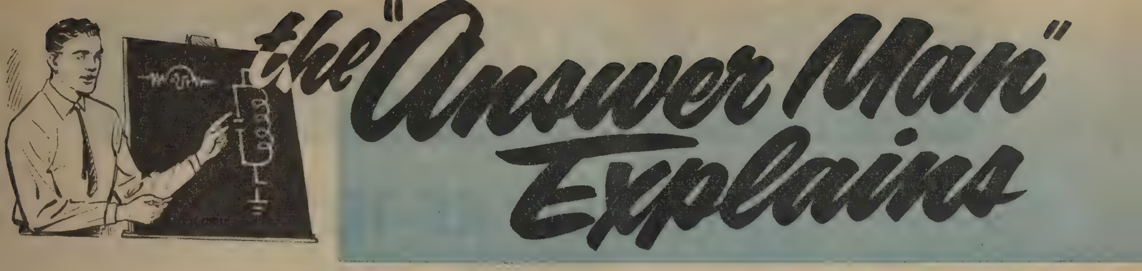


the "Answer Man" Explains

Operational Amplifier

What is an operational amplifier? Is it something to do with medical electronics?

The term "operational" refers not to surgical activities, as one might perhaps guess, although operational amplifiers do find use in the medical electronics field. Rather, the term refers to the way in which such amplifiers are used to perform mathematical operations such as adding, inverting, intergration, and differentiation.

Perhaps the main use of operational amplifiers is in analogue computers, where considerable numbers of such amplifiers are used in the electronic simulation of the components or characteristics of physical systems, electric power networks, or mathematical equations.

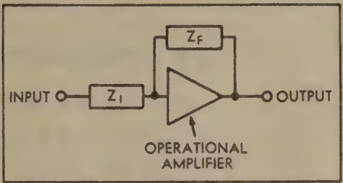
For instance, if it is desired to find out in advance the transient performance (reaction to sudden changes of input or load, etc.) of a large servomechanism to be used to control the position of a piece of machinery, and it is known that the behaviour of the servomechanism will be described by a very complex differential equation or set of such equations, the operational amplifiers of an analogue computer can be used to simulate the system by carrying out the same mathematical operations prescribed by the equations on a given input voltage.

The analogue computer will then show the design engineer in terms of voltage variations what will happen in the final servomechanism in terms of machinery position. In other words, it solves the complicated equations describing the equipment behaviour for him, giving him a set of voltage graphs from which he can determine whether he should modify his design.

Operational amplifiers are not only used in analogue computers, however. They also find use in other fields of electronics — in fact, they are used wherever the application calls for accurate mathematical operations to be carried out on circuit voltages. They are often used in servomechanisms themselves, where reference and feedback signals may need to be added, inverted, differentiated and so on to achieve the best possible performance from the system.

Bascially the operational amplifer itself is a very high gain DC amplifier specially designed to have very stable performance. Considerable design effort goes into such amplifiers to ensure that their output remains constant for a given input and does not "drift" or slowly change in DC level with supply voltage, component or temperature variations.

Usual operational amplifiers have gains of above 1,000 and up to 50,000, the higher gain units being used where very high accuracy is required.



So-called "straight" or conventional DC amplifier circuits may be employed, but where high gains are required it is difficult to keep the drift of such circuits to a sufficiently low level. To remedy this, special "drift corrector" circuits may be added to the basic amplifier, or alternatively drift-free amplifiers using the "chopper" or "carrier" principle may be employed.

In these types of amplifier the DC input signal is not amplified directly but is used to modulate an AC carrier signal, which is then amplified in an AC amplifier and finally demodulated to produce the DC output signal. As drift-free AC amplifiers are relatively easy to design, this results in a very stable amplifier unit.

In order to make the operational amplifier perform mathematical operations it is fitted with series input and negative feedback impedances, as indicated in the small diagram. In the diagram the amplifier itself is shown as a triangle, with the input impedance marked Z1 and the feedback impedance Zf. Note that only the "active" side of the signal path is shown; the "earthy" side is assumed to be common and is not shown.

The operation performed by the amplifier depends upon the actual impedances used for Z1 and Zf. If both are resistors, inversion is performed with a gain depending upon their ratio; with Z1 a resistor and Zf a capacitor, integration ocurs, while the converse produces differentiation. Complex and multiple values of Z1 and Zf are used for complex operations and operations like addition and subtraction.

The boom made by supersonic aircraft — is it audio, is it dangerous and can it be prevented?

The only thing about this question which is vaguely electronic is the word "audio," but we'll answer your question briefly, nevertheless.

The subject has been closely studied by the U.S. Strategic Air Force in recent years and, some time ago, they issued a small brochure for public distribution.

They explain the phenomenon in the following terms:

"Sonic boom is caused by shock waves which build up around an aircraft flying at supersonic speeds . . .

"The waves form a cone, extending back from the nose of the plane, much like waves created by a boat speeding over water. The shock waves travel to the ground at the speed of sound and follow the path of the aircraft.

"The waves become audible when they slap against the surface of the earth just as water washing against the shore can be heard. This same kind of pressure wave is created by a common thunderclap.

"In level flight, at supersonic speeds, a B-58 actually drags the edge of the shock waves it produces along the ground over its entire flight path."

As will be apparent from the above, the boom is a sonic effect and therefore a form of "audio" power.

At present, the problem is confined to military aircraft, because these are the only varieties which regularly travel at supersonic speeds—that is, in excess of about 762mph at sea level. In a few years' time, the problem will arise with civil aircraft now under development.

There would appear to be little that can be done about eliminating the sonic boom, since it is fundamental in its origin. However, the severity of the boom decreases as the plane's altitude increases, due to natural dissipation of the energy in the atmosphere. It may not even be noticeable under certain conditions. Thus, there is an advantage if flight plans can be arranged to restrict supersonic travel, as far as possible, to very high altitudes and over sparsely populated areas.

The U.S. Air Force claims that sonic booms cannot cause basic structural damage or directly injure a person.

From nuclear and other tests, they say that pressures of 70 or more pounds per square foot are necessary to damage ground buildings, with 150 to 300lb being more typical.

Against this, the strongest sonic boom ever measured was 33 pounds per square foot, but this was registered on a mountain top a mere 300 feet from the passing test aircraft. Under normal operations the figure is more like 5 pounds per square foot. This is 10 times that from a normal thunder clap, but still a long way below the damage fringe.

The worst a sonic boom can be expected to do, according to the U.S. Air Force, is to break windows—usually those with inherent glass strains—open loosely latched doors, dislodge ornaments perched precariously on shelves and per-

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FREQUENCY RESPONSE	500 c/s—8.000 c/s ± 8dB
CONDITION:	
STANDARD MICROPHONE COMPARISON	
SOUND SOURCE DISTANCE	50 cm (19.68 inch)
SOUND SOURCE	30 cm (12 inch) SPEAKER
OUTPUT VOLTAGE	(OPEN CIRCUIT)
	O dB=1 v/μbar

RECEIVER PART:

TYPE	MAGNETIC
IMPEDANCE	8 OHM ± 15% at 1.000 c/s
SENSITIVITY	100 dB at 1.000 c/s
RESPONSE DEVIATION	± 5 dB at 1.000 c/s
NOMINAL POWER	50 mw
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CONDITION:

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haps aggravate plaster cracks which are already in existence.

None of these occurences are pleasant to contemplate, but they are a lot less serious than some of the situations which have been blamed — apparently unjustly — on to supersonic aircraft.

What exactly is a tunnel diode and what is it used for? I do not recall your magazine having discussed this somewhat mysterious device.

Although it has been some time since we published anything regarding the tunnel diode, we published probably the first article in Australia explaining its operation, in November 1959. This was followed by a simplified and fairly comprehensive article describing its operation and uses, in February 1961, and a further article in September 1961 discussing practical aspects and describing a power supply, a curve plotter and a low-power FM transmitter using a tunnel diode.

For a detailed description of the device and its operation, readers would be advised to refer to these earlier articles, as we can hardly give a really satisfying answer to the question in the limited space available here. However, we will try to give a brief idea of the device for those who are completely unfamiliar with it.

As the name implies, the tunnel diode is a semiconductor junction diode. It is usually a germanium device, although a few gallium-arsenide types have been produced.

Under conditions of pronounced forward biasing the tunnel diode behaves very much like an ordinary junction diode — it has low resistance. However if the forward bias is reduced the tunnel diode increases in AC resistance quite rapidly; at a certain critical bias value it will continue to support direct current flow but becomes an open circuit for AC.

NEGATIVE RESISTANCE

If the bias is reduced beyond this point the effective AC resistance of the device reduces in value again, but has the somewhat peculiar property of being negative rather than positive resistance —in other words, over a critical region of the biasing, decrease of the bias voltage produces an INCREASE in current!

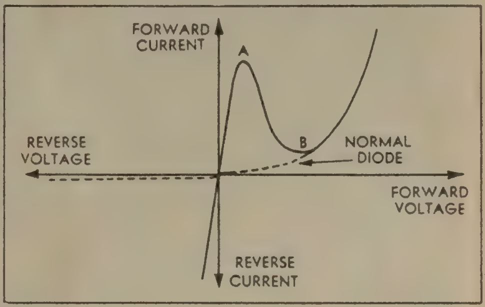
Still more reduction of the bias voltage causes the AC resistance of the diode to rise to infinity again, and finally it assumes a low positive resistance value as the bias is dropped to zero.

The characteristic of the tunnel diode is shown in the diagram and compared with a normal junction diode. Point B is where the first rise to infinite AC resistance mentioned above occurs, point A is where the second rise occurs, and the backwards-sloping section of the curve between them is the negative-resistance region. Points A and B are usually called the "peak" and the "trough" respectively.

At this stage we could well explain how it is that the tunnel diode behaves in this fashion, but unfortunately this is quite a long story (see the Feb., 1961, article). Instead, we will content ourselves with a brief discussion of its uses.

It is the negative resistance behaviour of the tunnel diode over part of its range which makes it of use in many circuits, because the effect of a negative resistance is just the opposite of that of a normal positive resistance. Whereas the normal resistance accounts for losses and attenuation, the negative resistance can cancel losses and produce amplification or oscillation.

If we connect a suitably biased tunnel diode across a normal tuned circuit, we can make its negative resistance cancel the loss resistance of the circuit and oscillations will be produced. If we arrange for the diode negative resistance only to partially cancel the losses, we can make the circuit amplify signals at the frequency concerned.



If the diode is connected in a resistive voltage "divider," and suitably biased, the output voltage can be arranged to be greater than the input—the circuit amplifies rather than attenuates.

Other uses for the tunnel diode make use not so much of its negative resistance behaviour but of the fact that over a certain range every forward current value corresponds to three resistance values and three possible working points. The negative resistance point is usually arranged to be unstable but, even so, the diode has two stable operating points for each current value.

Because of this, the diode can be arranged as a bistable or monostable flip-flop, switched between the alternative operating points under the influence of input pulses. Because it is able to switch extremely rapidly, it is finding considerable use in computers and other data processing applications.

Although it is a versatile device and may be used to make simple amplifiers and oscillator up to extremely high frequencies, the tunnel diode has not as yet made very much impact in the domestic and amateur fields—nor, for that matter, in many commercial fields.

It has been used in a commercial "dip" oscillator unit and various special VHF and UHF amplifiers, but its relatively low power and high cost have so far restricted its designer appeal. When these problems and one or two more technical problems concerning ease of application are solved, the tunnel diode may find much greater use in many fields.

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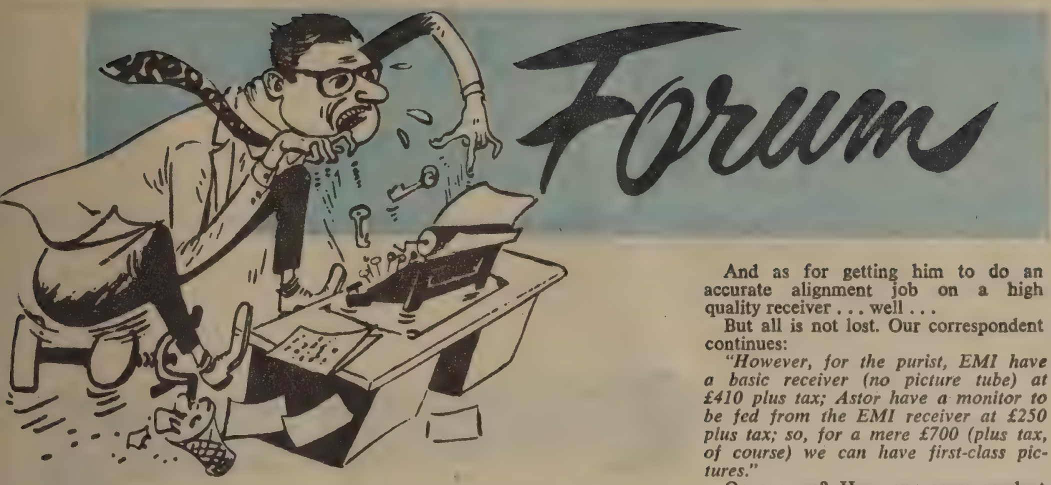

TV QUALITY — A LOST CAUSE?

The first part of "Forum," this month, is devoted to a letter from a reader connected with one of the Sydney Universities. Written in rather whimsical vein, it has to do with the subject of high fidelity television, both sight and sound.

By W. N. Williams

THE writer begins by apologising for the hand-written script and the eneral style of the letter but explains hat it represents, not so much an rdered series of observations, as a kind f "stream of consciousness" record.

What a wonderfully euphemistic hrase. It should prove most useful to whole generation of students, faced vith the task of writing essays, reports nd such like.

For purposes of publication we have eemed it wise to dip here and there nto the "stream of consciousness" and hereby achieve better continuity of bservation and comment. Our corespondent begins:

"When you mentioned high quality elevision pictures some time ago, your ronouncements on the topic seemed to lose the matter finally. But the "Let's uy An Argument" for January seemed o reopen the matter and I therefore add ny thoughts . . .

"First, I would imagine that high uality television pictures mean that the ircuit would be directly coupled; that contrast', 'brightness' and 'hold' conols would be independant; that there vould be a regulated EHT supply with ay, a VR tube in the power line to keep ertical and horizontal drives somewhat ndependant of mains fluctuations.

"Since your own published designs ave not embodied these features, I asume that you were not interested in igh quality pictures.

"The deflection coils would have to e carefully designed and manufactur-d. Would any firm in Australia turn ut garanteed coils at a reasonable rice?

"Having decided that the above could e arranged by R, TV and H (sorry, ELECTRONICS Australia) the next job s to align the IFs correctly and peak he video coils. Here is the first snag."

Perhaps we should break in at this oint.

It is true that the early R, TV and H designs did not go to the lengths desired by our correspondent. Quite deliberately, we kept the emphasis on simplicity and reliability and this policy, we believe, paid off very well. Consdering the (then) novelty of do-it-yourself television and the cost and complexity of even a simple television receiver, we had remarkably few complaints or reports of failure.

But the receiver described in the November and December issues, last, incorporated an array of circuit refinements in line with current design philosophy. Apparently our correspondent has overlooked this fact.

As regards direct coupling, I'll have something to say later on this subject.

Taking up the theme of alignment, our correspondent points out that high quality audio amplifiers can be built without becoming involved in critical adjustments but, in any case, high quality audio test equipment and its application is not outside the scope of an enthusiast who really wants to pursue the matter further. But, he says:

"When we look at television alignment, even the enthusiast cannot easily get together the equipment to do a GOOD job, let alone a HIGH QUALITY one. The ordinary serviceman is amazed when I tell him that I am prepared to bring ABN to best quality and, if necessary, sacrifice the commercial channels.

"As far as he is concerned, anybody who even looks at Channel 2 is a bit quaint in his mind!"

Our correspondent goes on to suggest that the average serviceman would regard as no less quaint a request to set the scanning adjustments to give the correct picture aspect ratio, despite the resulting unlighted areas on the screen. To a serviceman, overscan is so much the order of the day that it must be right.

And as for getting him to do an accurate alignment job on a high quality receiver . . . well . . .

But all is not lost. Our correspondent continues:

"However, for the purist, EMI have a basic receiver (no picture tube) at £410 plus tax; Astor have a monitor to be fed from the EMI receiver at £250 plus tax; so, for a mere £700 (plus tax, of course) we can have first-class pictures."

Or can we? Here our correspondent takes up a theme which sounds strangely like the old one relating to our present AM broadcasting (and reception) system:

"But now comes the further snag. An engineer from one of the local stations says that they are not really interested in transmitting anything above 3.5MC.

"A second station transmits a signal which seems definitely to be regulated, information wise, to match AC coupled sets; quite a curious device, you will agree.

"The third station freely admit to the problem 'what constitutes a black level' or 'how does one set up a monitor?'

"They regard this as a most important question but not yet solved; a picture that looks good with one monitor looks horrible on another (and perhaps better) one, with regulated EHT.

"What sort of a receiver do they transmit the picture to suit?

"And with that group of pictures to choose from, what does the receiver do?"

PROVOCATIVE

Here's a group of provocative statements if ever there was one.

First comes the statement that a certain local (i.e. Sydney) TV station is not really interested in transmitting anything above 3.5MC.

I wonder whether this relates to the capacity of the basic equipment or the limitations of much available program material — reduction prints, cine recordings and remote generation tapes.

I can well imagine an engineer expressing himself as satisfied if he could maintain the equivalent video content of such material at a limit of 3.5MC.

Equally, he might make a similar statement, prompted by a knowledge of the video characteristics of the average domestic TV receiver; something along the lines that, if they can transmit video components up to 3.5MC, viewers generally will remain blissfully content.

But when it comes to studio programs and master tapes, I've seen or heard little to suggest a careless sacrificing of standards. On the contrary, I've sensed quite a dedication to quality among the engineering staff on Australian television stations. In Sydney, at least, this has been sharpened by the efforts of the new Channel 10.

Still, when a correspondent makes

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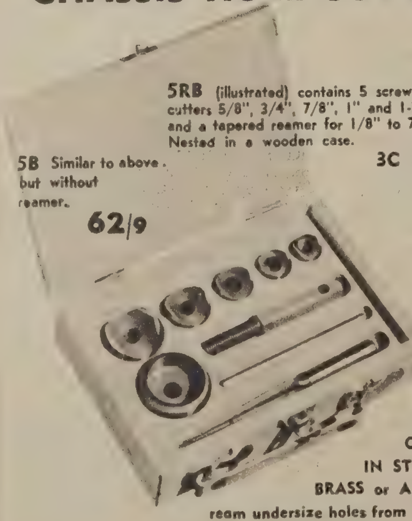

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RADIO COMPONENTS TOO COSTLY

Dear Mr. Williams,

Your editorial on "Component Costs" in the March issue prompted me to write and buy an argument.

I have been a regular reader of the magazine since it cost sixpence. I built many projects in the magazine and, honestly, I must say that I have never saved a penny on the cost of a radio, amplifier or test instruments completely assembled.

The last thing I built was the audio part of the number 7 "Playmaster". I had many of the resistors, capacitors, etc., but I spent nearly £20 to buy the rest. Now look at the magazine and see the price of a completely assembled amplifier . . . £29, £31, etc,

Look at the February issue also and tell me if we radio amateurs are not plainly robbed when buying spare parts A half-watt resistor 8d. plus tax; an IF transformer 25/- — for an aluminium can and a few turns of wire!

I was willing to build the "Communications 8" receiver. Here the cost of the coil kit is £25 plus tax, mechanical filter £20 and so on. The total cost of parts is more than the assembled receiver sold in Sydney for £72½ or £92½ with mechanical filter.

What do you think about this?

Perhaps the radio retailers are selling assembled projects at less than cost and losing money for the benefit of radio amateurs! I don't know whether to cry or not over such generosity.

I have a wide knowledge of overseas prices, because I have been in many parts of the world, though now approaching retiring age. I am sorry to say that radio prices are dearer in Australia than anywhere else. What chance have boys to learn and experiment if everything he has to buy costs a fortune?

The best advice I can give them is to buy a good second hand set and strip it to use the parts. I have collected seven radios and, if I need parts, I'll strip one of them.

I will continue to read the magazine because I like it but I will not spend more money on radio parts. Now that I have let off steam, I feel better!

I wish continued success for you, your staff and the magazine,

Yours faithfully, C.C.

statements like this in print, you never know what may come to light!

As to the second station, which allegedly relates its monitoring to the needs of AC coupled receivers, I'm not at all sure.

The implication is that AC coupled receivers are in such majority that a station finds the alleged course of action justified.

But are they a majority? In sheer weight of numbers, I would imagine that straight AC coupled receivers would be outnumbered by far, these days, by hose with direct coupling or DC restoration.

Any estimate must be complicated, however, by the in-between receivers — hose which are ostensibly direct coupled but which fall short of complete modulation dependence by reason of AGC action, time constants in the video chain and/or EHT regulation effects.

WHAT DIFFERENCE?

One might also ask what difference here would be in the monitoring technique for AC coupled receivers and how he picture would be degraded as seen on other receivers.

If the offence is proven, how many other stations in Australia are likewise guilty?

This question might be a good one or readers to "kick around" a bit.

Observation number 3 is closely reated to the same general question because black level would obviously be one f the things affected by deliberate mismonitoring or by uncertainty as to the ight thing to do.

One of my confreres here may have put his finger on something with an obervation that one Sydney station appears not to like dimly lit scenes in ilms. He claims to have noticed repeatedly that, when such a scene occurs, he brightness appears to come up hortly thereafter, as if someone has reacted and turned a knob.

One might speculate as to whether his is a human reaction or whether the aid station could be using an automatic ystem to integrate towards a constant verage brightness, more or less as is done for automatic photographic rinting.

If so — and it is a big "if" — this would not be a concession to the needs f AC coupled receivers, which would gnore any such brightness level change. Rather would it have an effect on direct coupled receivers, making them behave more like the AC coupled variety.

I wonder whether this is what our correspondent has noticed and, possibly, misinterpreted.

While on the general subject of brightess levels, I feel constrained to make general observation . . . not connected with the present letter.

There seems to be an impression, in some quarters, that black level and peak rightness level are natural, almost sacred," values which need only to be left alone to be right — not "mucked bout" with! In fact, nothing could be urther from the truth.

If you want an interesting exercise, try o work out definitions for black level nd peak brightness level, related to the rdinary visual situations.

For black level you'll find yourself ebating between zero light and a level hich is merely insufficient for the eye o derive visual information. But this latter level is heavily subjective and dependant on other visual conditions.

With peak brightness, you find yourself debating maximum possible brightness, less than maximum but verging on visual distress, and what the average person would define as "fully illuminated" — again with heavy dependance on subjective and ambient factors.

But, putting aside the difficulties of definition, quantitative and otherwise, we can ultimately expect to arrive at two fairly familiar propositions:

(1) The range of light levels which people are likely to judge visually as extending from black through to peak brightness is much narrower than from zero actual light to maximum conceivable light intensity.

(2) Pictorial reproduction systems are more restricted again in their practical brightness range—or range of tones—than the eye.

This being so, those trained in the fields of photography and television seek to avoid situations which combine an extremely wide range of brightness levels in the one scene—even the restricted range to which the eye might be expected to respond directly.

They variously choose subjects and/or light conditions, use "fill-in" lights and so on, deliberately to match the brightness range to the tone range and law of the medium with which they are working.

In short, the object of a photographic or television team is not so much to record native light values, as to produce a pictorial representation of a scene which is judged to be most acceptable to the ultimate viewer.

Thus, in every film, there is a high subjective content starting with those who designed the original emulsion, progressing through those who used it, to those who do the final processing. It is this subjectively derived result which is at stake.

If the film is shown on television further judgment is likely to be exercised. Brightness, black level, tone range may all fall under the monitoring hand, partly of technical necessity, partly of personal preference. From the process emerges a new set of values to be preserved or sacrificed.

All this has been said simply to emphasise that a great deal of judgment and manipulation intervenes between what purports to be the visual scene, au naturel, and the video signal which feeds the television transmitter.

Even at this point, the original DC component may not be carried through. The chances are that it will pass through AC coupled circuits and have the DC reinserted artifically, late in the chain.

By all means let us give thought to DC preservation, subtle forms of DC loss and to DC restoration techniques but let us equally beware the delusion that a lonely coupling capacitor in the domestic receiver is all that stands between our TV picture and the original scene, as the good Lord made it!

BACK TO LETTER

After all this, it calls for quite an effort to get back to the letter which I started out originally to quote. However, get back to it we must.

Having stated at much greater length what we merely outlined earlier, our correspondent seems just about to have convinced himself that Channels 2, 7 and 9 in Sydney are variously guilty of presentation errors, which would negate at least some of his efforts toward the ultimate in high fidelity picture reproduction. By now, he may

(Continued on page 126.)

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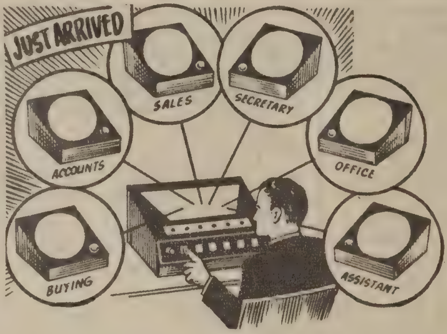

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The Serviceman

TV REPAIRS — BLACKSMITH STYLE!

The above heading is not intended to ridicule, in any way, those worthy tradesmen so long associated with sinewy hands and chestnut trees. It is simply meant to emphasise that, when hammer blows feature in television servicing, it makes news—of one kind or another!

MUST admit that there are times in a serviceman's life when a set of aditional blacksmith's muscles would be ery useful as, for example, when some eavy chassis has to be guided into place hile the only spare hand, foot and chin e performing supplementary tasks. Or hen some gargantuan console has to manhandled — solo.

But the most demanding tool that a rviceman has normally to wield is a air of bull-nose pliers. To wield a ammer would imply an approach to rvicing rather akin to Dr. Kildare getng to work on a patient equipped with riped apron and a large curved knife - or a chopper.

Yet, I must confess that a hammer, yce, and centre punch were the only ols I used on a TV set recently, when was found to be suffering from a bad se of frequency drift in the tuner. nd, rather ironically, the set belonged the local plumber, who would have en much more at home using these ols than I was.

The story started about six months o, when I was first called in to correct hat turned out to be a case of tuner ift. The set was a fairly recent model d the tuner used one of the recently veloped fine tuning systems in which e fine tuning adjustment for each chanl is carried in a simple "memory" um, thus ensuring that the set is corctly tuned every time a channel is lected. Considering the number of eople who can't tune a TV set this is ne of the really worthwhile improveents which the industry has produced recent years.

RIFT SEEMED SLIGHT

In this case the amount of drift, while ough to be noticed by the customer, as not really serious, at least in the nse that there was plenty of adjustment ailable on all channels to correct the uation. There was nothing to arouse y suspicions, and I simply assumed at the drift was due to normal valve ing.

When I was called to the set recently, owever, it was obvious that the trouble as a good deal more serious. The owner mplained that he could no longer ceive channels 7 or 9, while channel 2, hough still visible, was giving a very or picture.

Normally, when confronted by a drift serious as this, I first change the conrter valve. Experience has taught me at it is a frequent cause of this fault d, what is more, if not replaced, will ually fail altogether within a few months. In short, it is usually a good indication that the valve is on the way out.

But it was not so in this case. A new valve had no effect and when I tried to adjust the fine tuning I found that I needed so much movement to even approach the correct setting, that I had run out of adjustment before the performance was anywhere near right. Fairly obviously, this was something more than a routine fault and needed to be treated accordingly. I packed the chassis into the truck and took it back to the shop.

There I went over the routine again, just to make sure that I wasn't a victim of circumstances. In particular I tried yet another converter valve, but with the same result.

So it looked as though the tuner might have to come out and be sent to the manufacturers or a tuner reconditioning organisation. While there are a lot of things a serviceman can do around a tuner, the really curly ones are best left to those who have the experience and equipment to do the job properly. If nothing else, it is a good deal more economical.

However, I decided that I would first contact the manufacturer. After all, it could be something relatively simple once it was pinpointed, and it would enable me to get the set back to the customer a good deal quicker if it was.

The manufacturer's engineer was most helpful, and I sensed immediately that he had encountered the trouble before.

"Well, it could be a purely electrical problem," he said, cautiously, "But I think you will find it is a simple mechanical one. In this tuner the memory drum is a push fit on the shaft and we have had a few cases where the plastic gear, which normally grips the shaft, has not been tight enough and has allowed the whole assembly to move forward. This throws the entire fine tuning system out of operation."

He suggested that I examine the memory drum section in greater detail and, if this proved to be the trouble, to adopt a routine which they had worked out, and which he gave me in some detail.

Thus alerted, I took another look at the drum. Sure enough, it was obvious that this diagnosis was correct, judging by its position on the shaft. On the other hand, a casual check would probably not have revealed anything suspicious. The drum was still quite tight on the shaft — tight enough to turn it when the channel selector knob was operated — but had simply moved forward from its correct position.

In the light of this, it now seemed obvious that the movement of the drum along the shaft must have been a very gradual process. Apparently it simply wasn't tight enough to prevent it moving forward a tiny fraction of an inch every time the channel selector knob was operated.

That much established, I came back to the essential practical problem of repairs. First the tuner had to come out, and this was really the most electronic part of the job. At least I had to use a soldering iron, and disconnect some leads, if this puts it in such a class.

Once out, I moved over to the "heavy duty" bench, where I have a solid vyce. I sat the tuner upright in the vyce, with the normal front facing upwards and gripped by the rear end of the main shaft which is normally provided to couple to the tuning motor, where one is used. This shaft has two opposite flats, making it easy to grip.

WHAT TO DO

Then, using a hammer and a small block of wood as a drift, I gently tapped the memory drum back into place. Significantly, it took quite a moderate force to drive it back, once again confirming the rather insidious nature of the fault, whereby the drum was able to "drift" forward while still being apparently tight. There was no doubt when it had gone the full distance, since it came up against a definite barrier, in the form of a collar. So far, so good.

The next step was to ensure that the trouble did not happen again. Still acting on the makers' advice, I took a centre punch and proceeded to punch the face of the shaft at several points near the circumference. The idea was to expand the end of the shaft slightly, and thus retain the drum. As far as I could judge, it appeared to work exactly as planned.

You're probably thinking that all this sounds pretty brutal, and I must confess that I had some misgivings about it myself. However, looking at it logically, it is not nearly as drastic as it sounds. All the work is done on the main shaft, which is gripped securely in the vyce. The rest of the tuner is simply supported by it and not subjected to any strain. However, I did take the precaution of removing the valves.

From then on it was a routine job of fitting the tuner back in the chassis, and re-adjusting the fine tuning screws. Assuming I did a satisfactory job with the centre punch, that should be the last I would hear of it.

Nevertheless, when delivering the set to the customer — and presenting my account — I couldn't help reflecting on the irony of the situation. The customer would have had available and been able to use all the tools I used for the job; the soldering iron, the vyce, the hammer, the centre punch. All he lacked was the knowledge of "where to hit."

You've probably heard the story from which this expression came, but I think it is worth recalling. It concerned an engineer who charged £50 to hit a wheel with a hammer and cure a machine of a stubborn fault which had defied everyone else. When queried by the owner, and accused of overcharging, the engineer broke the account into two separate items.

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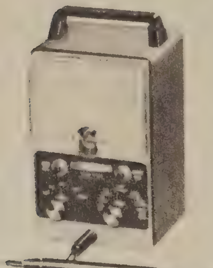

WORLD'S LARGEST-SELLING VTVM (top left) ● Single AC/Ohms/DC probe with switch. ● 7 AC, 7 DC and 7 Ohms ranges. ● Easy to read 4½" 200 ua meter. ● 1% precision resistors for high accuracy. **SPECIFICATIONS**—Meter scales: DC & AC (RMS): 0-1.5, 5, 15, 50, 150, 500, 1500 volts full scale. AC peak-to-peak: 0-4, 14, 40, 140, 400, 1400, 4000. Resistance: 10 ohm centre scale x1, x10, x100, x1000, x10K, x100K, x1 meg. Measures .1 ohm to 1000 megohms with internal battery. Meter: 4½" 200 ua movement. Multipliers: 1% precision type. Input resistance DC: 11 megohms (1 megohm in probe) on all ranges. Circuit: Balanced bridge (push-pull) using twin triode. Accuracy: DC=3%, AC=5% of full scale. Frequency response: =1 db, 25 cps to 1 mc (600 ohm source). Tubes: 12AU7, 6AL5. Battery: 1.5 volt, size "C" flashlight cell. Power requirements: 240 volt 50/60 cycle. Dimensions: 7⅜" H x 4 11/16" W x 4⅛" D.

KIT IM-11E, PRICE £27/16/11.

DELUXE "SERVICE BENCH" VTVM (mid-left). ● Measures AC volts (RMS), DC volts, resistance & DB. ● Separate 1.5 and 5 volt AC scales for high accuracy. **SPECIFICATIONS**—Meter scales DC & AC (RMS): 0-1.5, 5, 15, 50, 150, 500, 1500 volts full scale (1.5 and 5 volt AC ranges read on separate scales). Ohmmeter: Scale with 10 ohm centre x1, x10, x100, x1000, x10K, x100K, x1 meg. Measures 1 ohm to 100 megohms with internal battery. Multipliers: 1% precision type. Meter: 6" 200 ua movement. DC input resistance: 11 megohms (1 megohm in probe) on all ranges. AC imput impedance: 1 megohm shunted by 40 uuf (measured at input terminals). Circuit: Balanced bridge (push-pull) using twin triode. Accuracy: DC=3%, AC+5% of full scale. Frequency response: = 1 db 25 cps to 1 mc (600 ohm source). Tubes: 12AU7, 6AL5. Battery: 1.5 volt size "C" flashlight cell. Power requirements: 240 volts 50/60 cycle. Dimensions: 5" H x 12¾" W x4⅝" D.

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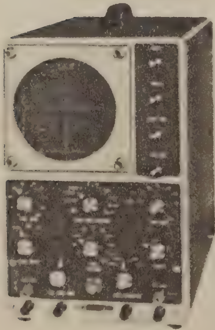

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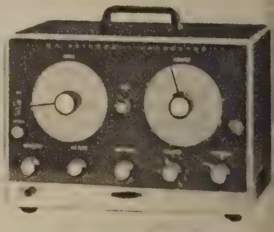
KIT IG52E, PRICE £70/17/6.



AUDIO GENERATOR (lower right). ● Switch-selected output frequencies, 10 cps to 100 kc. ● Less than .1 of 1% distortion between 20 and 20,000 cps. ● Output and frequency accurate to within 5%. ● Neat, compact styling—easy to use—excellent resetability. **SPECIFICATIONS**—Frequency: 10 cps to 100 kc, switch selected, 2 significant figures and multiplier. Output: 6 ranges 0 to .003, .01, .03, .1, .3, 1 volts RMS into external 600 ohms load or with internal load into Hi.Z, 2 ranges 0 to 3, 10 volts RMS into a minimum of 10,000 ohms, —60 db to =22 db in 8 steps —60 dbm to =2 dbm (0 dbm=1 mw in 600 ohms). Distortion: less than .1%, 20 to 20,000 cps. Tubes: (1) 5AU6, (1) 6CL6, (1) 6X4. Power: 240 volts AC, 50/60 cycles. Dimensions: 9½" W x 6½" H x 5" D.

KIT IG-72E, PRICE £44/8/9.

307 KENT STREET, SYDNEY. 29-1111.

WF

WARBURTON FRANKI

NEWCASTLE WEST: 844 Hunter Street. 60-4077: WOLLONGONG: 140 Keira Str., 2-5444: ADELAIDE: 204 Flinders St., 233-233: BRISBANE: 13 Chester St., Fortitude Valley, 51-5121: MELBOURNE: 220 Park St., South Melbourne, 69-0151: PERTH: Tough Instrument Co., 993 Hay St., 21-9767: HOBART and LAUNCESTON: Associated Agencies Pty. Ltd.

"For knowing where to hit: £49.
"Total: £50.

There is a good moral in that story. ;veryone is entitled to charge for "know-ng where to hit," and the serviceman is o exception. When people accuse ser-ice men of dishonest practice, and try to elate his charges to the cost of the few ninor components which might be in-olved, they conveniently forget the knowing how" part.

Yet a well-trained serviceman has ears of study and practical experience ehind him and, in addition to keeping is business solvent, is surely entitled to reasonable return for all this. New-omers to the game would be well ad-ised to remember this when adding up ll the items which contribute to the cost f a service call. Ignore it, and you'll nish up running your business for wages -and not very good ones at that!

NTERMITTENT FAULT

This month's intermittent was a rather nusual case. Whereas most such faults rovide a few symptoms which the cus-omer can pass on to the serviceman, his one seemed to be singularly lacking such assistance.

The customer was something of an udio enthusiast, with enough knowledge build most of his own gear from ublished instructions, but who was at omething of a loss when faced with a urly one. The equipment was his ver-on of the Playmaster 106 Tuner/ mplifier, built from a complete kit of arts supplied by one of the kit specia-sts.

He had, in fact, made a very good b of it, providing an excellent example f what can be achieved by a relatively experienced person working from a ell-prepared kit.

His complaint concerned the tuner rtion which, he claimed, went com-letely dead on occasions for no appar-nt reason. Apart from the fact that the ouble was confined to the tuner, there emed to be little more he could tell e. However, a little questioning re-ealed one other point: It had never iled while it was running, only when st switched on. In fact, this was a clue sorts, had I but realised it, but it emed of little significance at the time.

My first look at the set was in the stomer's home. I was in the neigh-ourhood and it seemed a good oppor-nity to investigate a particularly bad ries of failures which he had reported e previous day. You've guessed it, of urse. The set behaved perfectly as on as I walked in the door and nothing e could do would make it fail.

What was more, it played without issing a beat for the next week or , and both myself and the customer ere beginning to wonder if it was all agination. But it wasn't, and the unit as soon up to its old tricks again. evertheless there were still occasions hen it would go for several days at a ne without trouble.

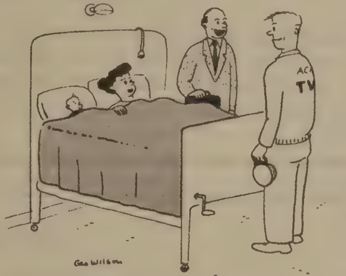
Since there is little future in trying pursue this kind of fault in the cus-mer's home, I finally suggested that bring it in to the shop and leave it th me as long as might be necessary. ere I set it up on a remote corner the bench, selected the least raucus the local stations, and let it play ftly while I went on with other work.

Since it seemed to be a function of the switch-on cycle I turned it off at regular intervals, let it rest for a few minutes, then turned it on again. Over the period of a whole day it responded perfectly every time. It looked as though it was going to be a long session.

Then I had a stroke of luck. About ten minutes before closing time I switched the set off, intending this to be the finish of testing for the day. I tidied up a few things, switched off the irons and test gear, and generally prepared to shut down for the night. I had even switched off most of the lights.

Then, for some trivial reason, I moved over to the bench near the set, which was now in relative darkness. On an impulse, I decided to give it one last try, and flicked on the power switch.

In the semi-darkness I was more than usually conscious of the valve heaters as they warmed up, and I suddenly became aware that one of those in the tuner—the 6BA6—was not behaving normally. It had started to glow along with the rest, then had suddenly died away. A moment later it came good again, began to pick up, then failed a second time. This process continued, but with the "off" times becoming shorter and the "on" times longer until eventually it seemed to settle down to normal operation. By this time the set was playing.



"Perhaps you'd like to take out a year's service contract . . ."
(P. F. Reporter)

So that was it; an intermittent valve heater. More important, a temperature conscious one whereby, apparently, the valve was most likely to fail when it was cold, and least likely to when it was hot. This would account for the failures being confined to the switch-on cycle, possibly when the ambient temperature was below a critical level.

Had it not been for the purely fortuitious act of switching the set on in semi-darkness, it might have taken me a lot longer to track it down. I might even have had to wait for the onset of winter.

Which all goes to show that the old habit of "looking in the valves to see if they are alight"—and which most of us tend to scorn—does have a place in the scheme of things.

And, by the same token, so does a quota of luck.

On a completely different subject, I have noticed recently that a number of customers seem to be adopting a strange fatalistic attitude toward radio receiver breakdowns; apparently based on the idea that a set which is more than about five or six years old is not worth fixing.

As you probably realise, these remarks were promped by a particular case, but it is by no means unique. On several occasions recently I have found myself convincing customers, apparently against their own pre-conceived ideas, that a set is worth fixing.

This particular story involved a mantel radio of well-known brand, about eight years old which, apparently, had never missed a beat until now. I also gained the impression that it was a somewhat cherished possession. The cabinet, a nice moulded type, was as shiny and free from scratches as the day it was bought; all the knobs were intact; no one had poked pencils through the speaker silk—or cone; none of the feet was missing; the cord was not even tangled.

It sat on a neat little shelf in a spotless kitchen, presided over by an obviously very house-proud housewife. I didn't need to be told that it was her main source of daytime entertainment.

Yet, in spite of this background, it was almost apologetically that I was asked whether I thought the set was worth fixing and then, I imagine, only because I happened to be in the house to check the TV set.

There was no suggestion that a set was no longer needed. On the contrary, the owner and his wife had seriously considered buying a new set, to the point where they had visited a number of appliance shops, studied what was available, and looked at the price tags.

This last point was the problem. A set of the same general type and quality was not cheap, and the owner felt disinclinded, at this time amyway, to become involved in a hire-purchase arrangement. He confessed that he had even considered digging into the funds that he had set aside for his annual holidays—with the inevitable result that the latter would have to be seriously curtailed.

This, then, was the reason I had been approached; to see whether as a last resort, the set might be worth fixing. But note that "last resort" bit. Presumably, had the owner not been temporarily financially embarrassed, he would simply have gone out and bought a new set and tossed the old one in the garbage can.

And what was wrong with the set? As far as the owner was concerned, it had simply stopped working. No smoke or smell, nothing intermittent, no nebulous distortion problems, or anything of a like nature.

STRAIGHT FORWARD

Now no one minds a good straight forward complete failure. They seldom take long to track down, are in no way ambiguious, and give one hundred per cent customer satisfaction. I advised the owner that although I couldn't give him a firm quote on the spot, it was very unlikely that the job would cost more than a few pounds; say the cost of a valve plus a service fee. He seemed to think that this was almost too good to be true, but readily agreed to my taking the set back to the shop.

After that the story of the set itself is almost an anti-climax. Checked on the bench it was completely dead, just as the owner had said. I slipped the chassis out of the cabinet, intending first to check

(Continued on page 77)

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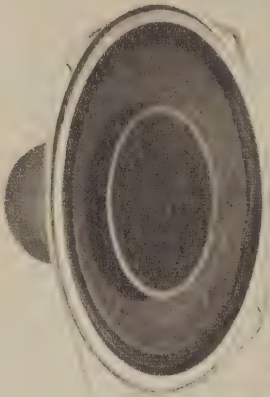

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4 CHANNEL PRE-AMPLIFIER

MICROPHONE MIXER

MODEL G.300-V

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- Provision for plugging in reverberation unit.
- External channel input for multi-microphone work (e.g. a second G300-V mixer connected in this channel will provide 8 microphone Inputs).
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TECHNICAL SPECIFICATIONS

The GELOSO G300-V unit is a five transistor high quality 4-channel microphone mixer using low noise AC107 transistors in the microphone stages and a AC126 in the output stage providing 150 millivolts to suitably feed the pickup inputs of tape recorders, high fidelity amplifiers and public address systems. Each channel provides for low impedance microphones (200 ohms) and the frequency response is 30 to 15,000 c.p.s. ± 2db. The G300-V is fully shielded, (operates from 110-240 volts AC or from 9-volts DC. Two units can be used for stereo recording or can be plugged up in tandem to provide 8-channels for monophonic recording. The AC power supply is inbuilt and a compartment provided for battery supply.

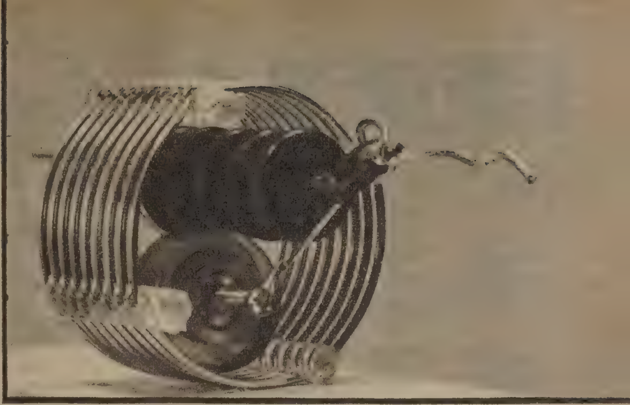
PRICE: £33/6/- (Inc. S. Tax)

WILLIAM WILLIS & CO. PTY. LTD.

428 Elizabeth Street, Melbourne, C.I. Vic. Phone 34-6539

A MULTI-BAND TRAP ANTENNA FOR AMATEURS

The problem of providing an antenna to cover all of the HF amatenr bands is one which confronts most amateur operators at some stage or another. A separate co-ax fed dipole on each band is an ideal solution, but one which often proves impractical in many locations.



Our multi-band trap dipole requires two of the tuned circuits illustrated above, one in each "leg" of the antenna. The traps resonate at 7MC.

WHERE separate dipoles become impractical a single, multi-band antenna is the logical solution and, in recent years, two particular designs of multi-band antenna systems seem to have achieved popularity over all other types.

The first of these consists of multiple dipoles hung one underneath the other and all fed from a common co-ax feedline, as shown in figure 1. The dimensions given in our diagram provide half-wave dipoles for the 80, 40, 20 and 10-meter bands with 15 meters being covered by the 40-meter dipole which acts as three half-waves.

The system works reasonably well but has the disadvantage of being cumbersome to make and mount. The dipoles can be hung about 3 to 4 inches below each other but small weights need to be attached, by an insulated cord, to the ends of the 40, 20 and 10 meter dipoles to prevent the whole arrangement from becoming tangled in a high wind.

A reduction in the overall length of the multiband antenna and a considerable simplification in construction can be achieved by the use of a "trap" dipole as shown in figure 2.

In this arrangement the traps are designed to resonate at 7MC, so that they isolate the inner and outer sections of the antenna by virtue of the high impedance they provide at this frequency. The inner section of the antenna therefore becomes a half-wave dipole at 40 meters, in fact, it will be seen that the ength of the inner sections is close to the normal length of a half-wave at 40 meters, particularly when the capacitive end-effect of the traps is taken into account.

At 80 meters the traps will exhibit a high capacitive reactance and a low inductive reactance, so that they act as series inductors between the two secions. The effect of this is to electrically shorten the length of the antenna at this frequency so that, although its overall ength is physically shorter than a normal half wavelength at 80 meters, it is actually an electrical half wavelength ong.

At frequencies higher than 7MC, the raps exhibit high inductive reactance and low capacitive reactance so that they act as capacitors between the inner and outer sections. The effect of this is to decrease the electrical length of the anenna so that at 20 meters it looks like hree half wavelengths, at 15 meters five half wavelengths and at 10 meters seven half wavelengths.

In saying the antenna looks like a certain number of half wavelengths at a given frequency we are, perhaps, taking ome liberty because in practice it will not be exactly resonant at the three higher frequencies, some degree of compromise being necessary. It will be found, however, that the VSWR under the worst conditions will not exceed approximately 1.8 to 1, and this is quite acceptable.

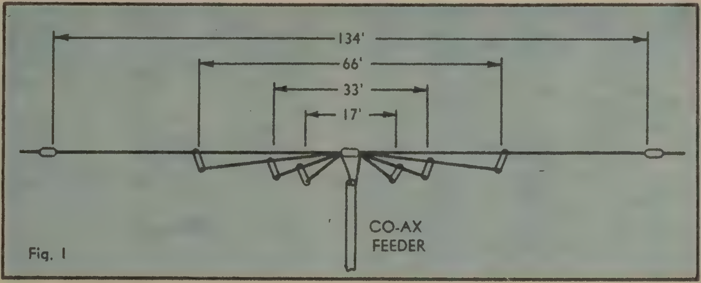


Fig. 1

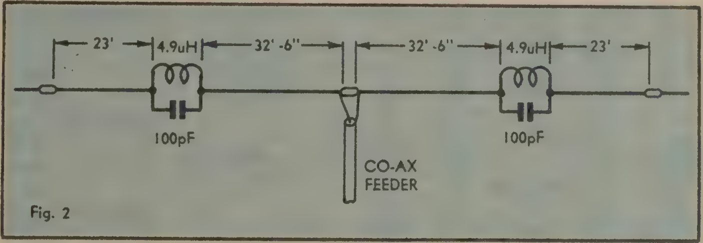


Fig. 2

All the important dimensions of our multi-band antennas are given in the above drawings. Small weights (not shown in the drawing) should be suspended from the inner dipoles of the multi-element unit to prevent tangling in high winds.

In the prototype antenna which we constructed to the dimensions given in figure 2, the VSWR on 80, 40 and 20 meters did not exceed 1.2 to 1 while on 10 meters we achieved a VSWR of 1.4 to 1. The worst condition was the lower end of the 15-meter band where a VSWR of 1.8 to 1 was recorded.

Each of the traps in our antenna consists of a 100pF—20kV ceramic capacitor wired across a standard strain insulator and with both of these components placed inside 9 turns of "AIR-DUX" type 2006 coil former. The ends of the coil are simply looped through the end holes of the strain insulator and soldered to the capacitor to form a parallel tuned circuit.

The inner and outer antenna sections connect one to each end of the insulator with solid mechanical connections. The antenna wire plus the connections to the coil and capacitor should be soldered together to make a good electrical connection at each end of the trap. The final construction of the trap should be such that all the mechanical strain of the antenna is taken by the insulator with the coil and capacitor simply suspended from the insulator.

The high voltage ceramic capacitors were chosen because they are highly resistant to weathering and will easily withstand the maximum voltages produced by a 150 watt transmitter feeding the antenna. They are, however, fairly expensive and lower voltage types could be used if the antenna is to be used only for receiving. In this case the capacitors could be given a liberal coating of epoxy resin ("Araldite" would do fine) before placing them out in the weather.

The "AIR-DUX" formers are now available in this country and are quite reasonably priced but for those who wish to construct their own inductors the details are as follows: 9 turns of 12SWG tinned copper or enamelled wire spaced 6 turns to the inch and 2½ inches in diameter.

Any transmitter used with this antenna should have a low harmonic output since this unit, in common with other multi-band types, is an excellent radiator of any harmonics which may coincide with one or another of its resonant modes. ■

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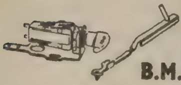
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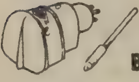
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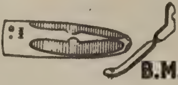
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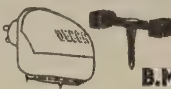

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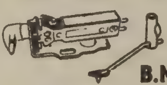
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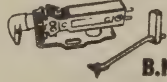
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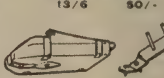
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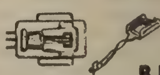
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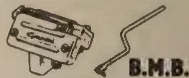
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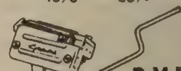
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Sapphire only. 13/6

B.M.B. 39

B.M.B.39 Goldring 580 and 600 cartridge, supplied in standard and L.P.
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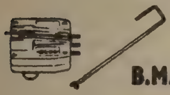
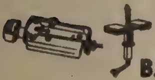
B.M.B. 40

B.M.B.40 Collaro 5606. cartridge, supplied in standard and L.P.
Sapphire and Diamond.
13/6 50/-



B.M.B. 41

B.M.B.41 Acos 71-3, 71-4 cartridge Supplied in stereo only.
Sapphire and Diamond.
26/- 70/-



B.M.B. 42

B.M.B.42 Garrard T.O.M. 2 cartridge, dual stylus.
Sapphire only. 13/6

B.M.B. 43

B.M.B.43 Philips A.G. 3063 and A.G. 3060 Heads Stereo/L.P.
A.G. 3301 turnover cartridge, Standard and Stereo/L.P. (Standard having shorter arm)
Sapphire and Diamond.
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B.M.B. 44

B.M.B.44 Garrard G.C.E. 12. Supplied in stereo and standard.
Sapphire and Diamond.
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B.M.B. 45

B.M.B.45 Perpetuum Ebner P.E.12. cartridge. Dual stylus.
Sapphire only. 26/-

B.M.B. 46

B.M.B.46 Elac MST.1, MST.2, cartridge. Supplied in standard and L.P.
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B.M.B. 47

B.M.B.47 E.M.I. R.S.3 cartridge. Supplied in standard and L.P.
Sapphire only. 13/6

B.M.B. 48

B.M.B.48 E.V. Power Point 51 Red, Dual L.P.
Sapphire only. 50/-

B.M.B. 49

B.M.B.49 E.V. Power Point 56 Blue. Dual L.P./Standard.
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B.M.B. 50

B.M.B.50 Steig Reutter. Standard and Stereo/L.P.
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B.M.B. 51

B.M.B.51 Teppaz Monaural. Standard and L.P.
Sapphire only. 13/6

B.M.B. 52

B.M.B.52 Teppaz Stereo. Stereo only.
Sapphire only. 13/6

B.M.B. 53

B.M.B.53 B.S.R. T.C.12 H. M. and S. cartridges. Supplied in standard and stereo/L.P.
Sapphire and Diamond.
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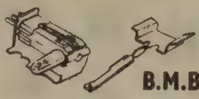
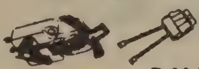


B.M.B. 54

B.M.B.54 Garrard E.V. 26A cartridge. Supplied in standard and stereo/L.P.
Sapphire and Diamond.
13/6 50/-



B.M.B. 55

B.M.B.55 Decca 06968/A Stereo Cartridge Dual Stylus. Stereo/L.P. and Standard.
Sapphire and Diamond.
26/- 70/-

B.M.B. 56

B.M.B. 57

B.M.B. 56 B.M.B 5MXD Crystal Cartridge Dual Stylus. Standard/LP.
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B.M.B. 58

B.M.B.58 B.M.B. 715 S Dual Stereo L.P. Standard
Sapphire and Diamond.
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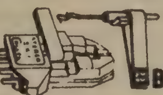
B.M.B. 59

B.M.B.59 B.S.R.ST3 C1 Stereo ceramic cartridge. Dual stylus. Standard and Stereo/L.P.
Sapphire and Diamond.
26/- 70/-

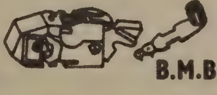


B.M.B. 60

B.M.B.60 Collel SK1 Stereo crystal cartridge Dual stylus Standard and Stereo/L P (Also fits Elac KST106 Stereo crystal cartridge SNM106 and Elac KST406 Stereo ceramic cartridge SNM406)
Sapphire and Diamond
26/- 70/-

B.M.B. 61

B.M.B.61 Collel SC1 Stereo ceramic cartridge. Dual stylus. Standard and Stereo/L.P.
Sapphire and Diamond.
26/- 70/-



B.M.B. 62

B.M.B.62 Dual CDS2/3 cartridge DN2. Dual stylus. Standard/L.P.
Sapphire and Diamond.
26/- 70/-

B.M.B. 63

B.M.B.63 Dual CDS320/3 cartridge DN3. Dual stylus. Standard and Stereo/L P. Also fits CDS520/3 and CDS310 cartridges.
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B.M.B. 64

B.M.B.64 Dual CDS620 cartridge DN4. Supplied in Standard and Stereo/L.P.
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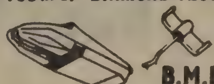
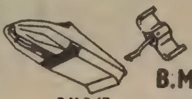
B.M.B. 65

B.M.B.65 Elac PE180, BST400, KST100, cartridges SNM100. Dual stylus. Standard and Stereo/L.P.
Sapphire and Diamond.
26/- 70/-



B.M.B. 66

B.M.B.66 Elac KST101 Stereo cartridge SM101 Stereo L.P. only.
Sapphire and Diamond.
13/6 50/-



B.M.B. 67

B.M.B.67 Elac PE182, BST402, KST102 cartridges SNM102. Dual stylus. Standard and Stereo/L.P.
Sapphire and Diamond
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B.M.B. 68

B.M.B.68 Elac KST103 cartridge SM103 Stereo L.P. only
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B.M.B. 69

B.M.B.69 Elac KST104, PE184 cartridges. Dual stylus. Standard and Stereo/L.P
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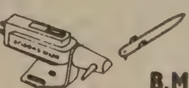

B.M.B. 70

B.M.B.70 Goldring MX1, MX2L, MX2M, MX2H, CM50 Monaural cartridges SX10L, SX10M Stereo cartridges. Standard L.P. and Stereo/L.P.
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B.M.B. 71

B.M.B.71 Philips 3306/3310 Heads. Dual stylus. Standard and Stereo/L.P.
Sapphire and Diamond.
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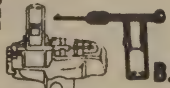

B.M.B. 72

B.M.B.72 Sonotone 9T Stereo cartridge. Dual stylus. Standard and Stereo/L.P.
Sapphire and Diamond.
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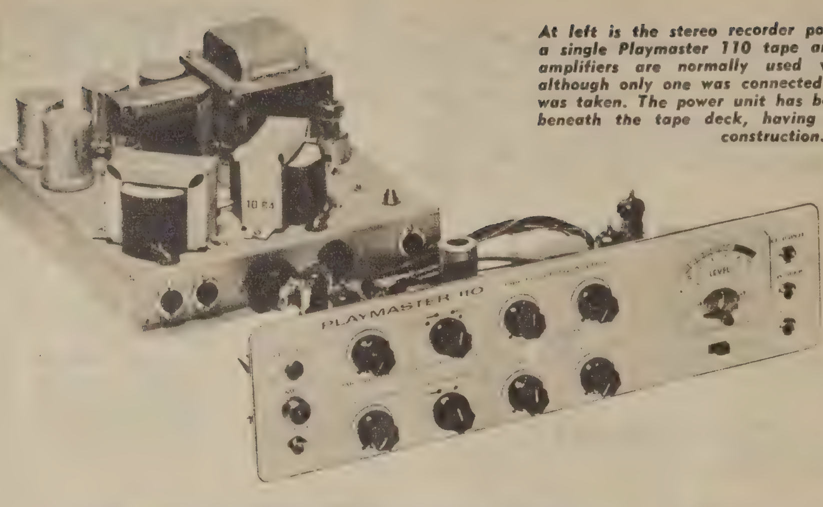


At left is the stereo recorder power unit connected to a single Playmaster 110 tape amplifier. Two of these amplifiers are normally used with the power unit, although only one was connected when this photograph was taken. The power unit has been designed to mount beneath the tape deck, having a chassis of shallow construction.

A COMPLETE STEREO RECORDER USING THE 'PLAYMASTER 110' TAPE AMPLIFIER UNIT

The second power unit to be described as part of the "Playmaster 110" tape system, the unit described in this article combines with two of the type 110 amplifiers and a suitable high-quality deck to form a complete stereo tape recorder system. Used with suitable microphones and loudspeakers it is capable of very high quality recording and reproduction, yet all components of the system have been designed to facilitate construction.

By Jamieson Rowe

LAST month, you may recall, we described an Adapter Power Unit which combined with either one or two of the "Playmaster 110" tape amplifiers of March to form either a mono or stereo tape adapter system—one requiring the use of an existing high-quality mono or stereo amplifier system for loudspeaker operation on playback. However, as there are applications where complete replay facilities are required in the tape unit itself, we describe this month a power unit which includes power output stages.

This power unit has two single-ended output channels and is intended for use with two type 110 amplifiers to make up a complete stereo tape recorder. A slightly modified version will be described in a following article, having a single push-pull output channel for those wanting to make up a complete high-quality mono recorder. Both versions will employ the same power supply, bias/erase oscillator and chassis.

Before describing the new power unit a correction must be made regarding an erroneous statement made in the April article. It was stated that the Bogen erase heads used on the Brenell deck are low impedence types, requiring less erase voltage than those used in such decks as the Collaro (English Magnavox). In fact, the Bogen erase heads are of relatively high impedence and considerably higher than the other types. It is the Bogen RECORD heads which are of relatively low impedance.

Because of the differing head impedances of the various decks, it is not possible to design an amplifier which will suit all decks without modification. However, the 110 tape system has been arranged to suit without modification decks having a head complement similar to that of the Brenell—high impedance erase, low impedance record, medium impedance replay (where used). With various modifications, it may be used with a number of other decks and head complements, as discussed in the appendix at the end of this article.

Let us now turn to the circuit of the new power unit for a brief discussion of its operation. The circuit may be split for discussion into three basic sections—the output amplifiers, the bias/erase ocillator and the power supply.

The output amplifier channels employ 6GW8 (ECL86) triode-pentode valves, using one valve per channel. The valves are connected in a two-stage feedback amplifier circuit having an output of approximately 3 watts RMS (in the voice coil). The input sensitivity of the channels is approximately 150-mV for full output.

The response of the channels is flat within 1dB from 35 cps to 19KC (approx), the 3dB down points occuring at 25cps and 25KC. Thus whether used for tape or gramophone reproduction the channels will give excellent tonal fidelity.

The output of the amplifier channels is at 15ohms impedance. It is taken to the 12-pin sockets, from which it passes to the 110 amplifier units and their "Output" jacks. This allows external speakers to be connected to the recorder system for high quality reproduction in the home. Any high quality 15ohm speakers in suitable enclosures could be used with the unit in this fashion, the recently described "Playmaster 109 Bookshelf" units (December 1964) being eminently suitable.

If external speakers are not used the output signals return to the power unit from the 110 amplifiers, and are fed to the internal speakers. These would typically take the form of small round or elliptical units mounted at each end of a portable case, or perhaps slightly larger units mounted in the halves of a split and removable case lid.

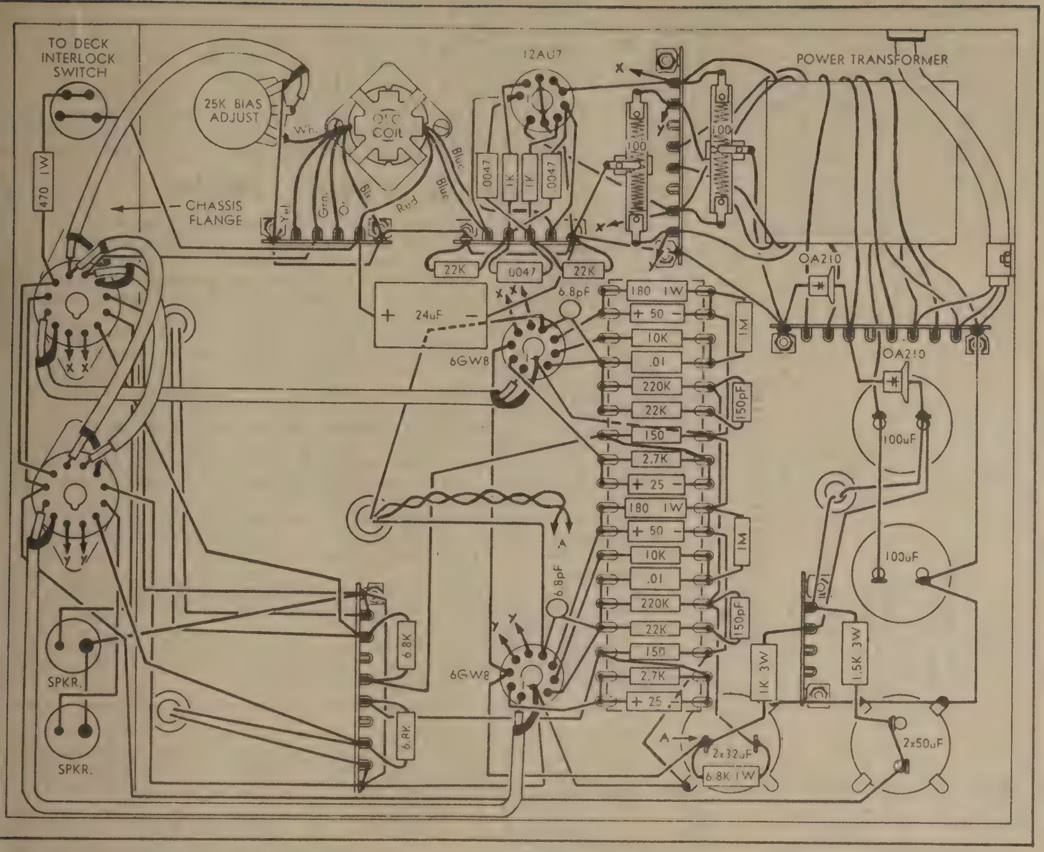
There is no reason why the internal speakers could not be larger, properly

SPECIFICATION

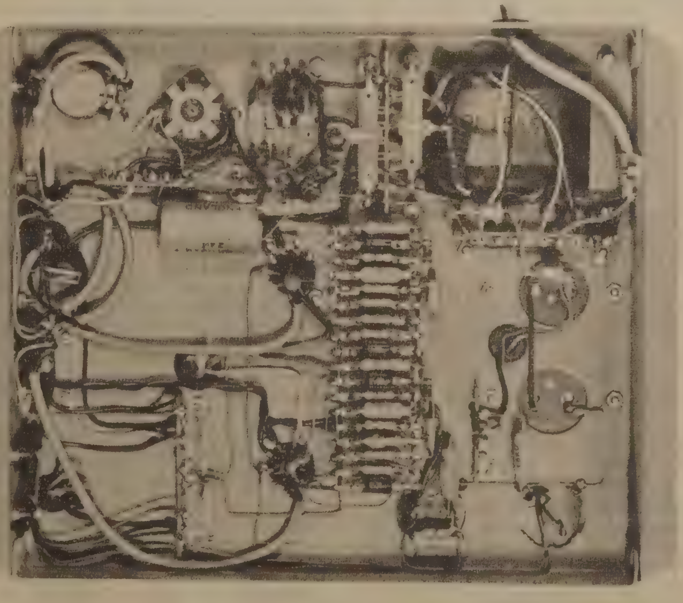
THE power unit described combines with two type 110 tape amplifiers and a high quality deck such as the Brenell Mark 5 Series 2 to form a complete stereo recorder. It contains power supply, erase/bias oscillator and replay power amplifiers.

The power amplifiers are single-ended output channels using 6GW8 valves and have an output of approximately 3W (RMS) maximum. Response is within 3dB from flat over the range 25cps—25KC, and the overall recorder response obtained will be close to that of the 110 amplifiers — 40cps to 19KC at 15ips, 40 cps to 18KC at 7.5ips, 40cps to 8.5KC at 3.75ips and 40cps to 4KC at 1.875ips (these figures refer to 3dB down points).

Using the replay system of the recorder for gramophone record reproduction from a crystal or ceramic pickup the response will be virtually the same as for the 15ips tape speed, and full bass and treble control is retained. For further specifications regarding the 110 amplifiers refer to the March article.



Above is a complete wiring diagram of the stereo recorder power unit, to allow construction by enthusiasts with little previous wiring experience. Below is an underchassis photograph of the unit, showing the actual wiring and placement of parts. These have been distorted in the above diagram where a literal representation would have impaired clarity.



nclosed units, of course, although this ould strictly only be possible if the pe recorder were to be made a "non-ortable" console unit — perhaps the asis of a complete home stereo system, nce it may be used for high-quality amophone reproduction.

In such a case the unit could well in-rporate two enclosures identical to the ookshelf units placed at opposite ends a longish console (the longer the etter, within reason!), or preferably use o Bookshelf enclosures as "internal" eakers separate from the deck and ectronics console.

The bias/erase oscillator is identical ith that used in the adapter power nit. It employs a 12AU7 valve in a ish-pull Hartley circuit, and delivers pure waveform to ensure quiet erasure d low recording distortion.

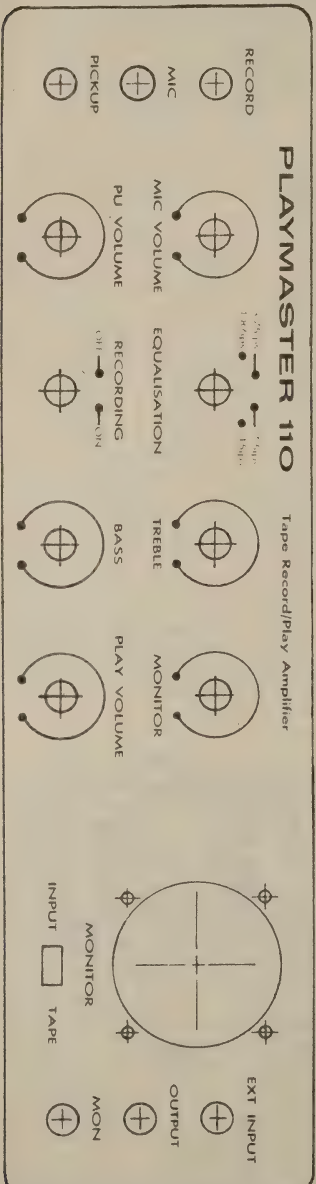
The actual coil used differs from that ed in the adapter power unit, as may seen from the photograph. As men-oned in last month's article, the first il was an original Brenell unit, but ese are not available in this country. ccordingly, arrangements were made r equivalent coils to be manufactured cally, by R.C.S. Radio Pty. Ltd.

The coil used in the new power unit in fact, one of the new R.C.S. units. uses the same colour code as the iginal Brenell coils to obviate ssible confusion if the latter should er become available. It is electrically uivalent to the Brenell coil but is ted with additional secondary winding rns which make it also suitable for e with decks having high impedance recording heads. Later on in the appendix we shall discuss the circuit changes necessary for such decks.

For reference, the R.C.S. coil is designated by the number 265. The connection to the secondary winding extension is colour coded yellow, as may be seen on the circuit.

The power supply section of the new unit is basically a voltage-doubler circuit using two 400 PIV 500mA silicon diodes (type 0A210, 1N1763, 1N2862, etc.). A power transformer having a 124V 150mA (DC) secondary rating is used, although a 125mA type could be used if available. The transformer is a horizontal mounting type and has two 6.3V 3A windings for heater supply.

HT for the power amplifier channels is taken direct from the voltage doubler output via a simple RC filter. The supply for the 110 amplifiers and the bias/erase oscillator receives more extensive filtering and decoupling by means of an LC filter employing a 14H 60mA choke, a 1.5K resistor and 100uF of bypass capacitance.



A reproduction of the front panel print of the Playmaster 110 amplifier, shown half scale. Full-sized unglazed prints are available from the information service at a cost of 5/, if required.

CORRECTIONS TO CIRCUITS, DIAGRAM

SINCE the Playmaster 110 tape amplifier was described in the March issue a small number of corrections and modifications to the design have been found to be desirable in order to improve its performance. These are explained briefly below, while those which involve circuit changes have been incorporated in the circuit diagrams reprinted on pages 64 and 65. Readers should modify the previous parts lists in accordance with the changes.

1. HT decoupling to the initial stages should be increased by making BOTH bypass capacitors 40uF/350VW (one was 32uF), and by increasing the first stages series resistor from 15K to 33K/1W.
2. For reduced replay preamp hum pickup from motors, etc., the grid resistor of the EF86 (V4) should be reduced from 470K to 220K.
3. To improve HF stability and reduce bias pickup the three replay equalisation resistors should be shunted with small capacitors—the 150K with with 220pF, the 82K with 100pF and the 56K with 33pF. Also the connections from the 12-pin power plug to the "output" jack should be made in shielded twin-conductor cable (see circuit on p. 65).
4. It has been found that the RF chokes used as substitutes for the erase heads (record "off") in the stereo versions are not really required. In fact they are BEST LEFT OUT because they inevitably radiate a certain amount of bias energy.
5. The 150K and 56K replay equalisation resistors were shown with transposed markings in the wiring diagram of p. 31 of the March issue. They are correctly shown in the circuit diagram.
6. The bias oscillator HT series resistor in the Adapter Power Unit of April should be marked 2.2K/3W, not 470 ohms/1W. The value of 470 ohms applies in the case of the Recorder Power Unit.

This degree of decoupling is required to ensure low-frequency stability, as the system possesses considerable gain and the tape replay equalisation is characterised by a substantial amount of bass boost.

Mechanically, the recorder power supply unit is constructed on a shallow rectangular pan-type chassis measuring 11in x 9in x 1¾in overall. The shallow chassis and the use of a horizontal mounting power transformer keep the total height of the unit to approximately 4½in, making it suitable for mounting beneath the deck mechanism.

The chassis has been designed so that it may be used either for the stereo recorder power unit described herein or for the push-pull mono recorder power unit to be described in a later article. The latter will have identical power supply and bias/erase oscillator sections, the only difference being that in place of two single-ended stereo output channels it will have a single push-pull channel using the same pair of 6GW8 valves.

The power supply section of the unit occupies almost half the chassis, due to the bulk of its components. The power transformer is in one corner, adjacent to which are the doubler electrolytics and the filter choke, with the two dual electrolytics occupying the remainder of this section of the chassis.

Of the remaining half of the chassis the bias oscillator section occupies approximately one-third, that adjacent the power transformer. The oscillator coil itself is mounted beneath the chassis, as is the bias setting pot. The shaft of the latter is available above the chassis, being cut short and provided with a slot for screwdriver adjustment.

The remainder of the chassis is taken up by the amplifier channels as may be seen in the photographs. The two medium-quality output transformers are mounted obliquely to conserve space, being adjacent to their respective valves. In the push-pull mono version, a single centrally placed transformer will be used.

The end of the chassis remote from the power supply section is used for the interconnection sockets. At the bias oscillator end a small four-pin socket is used as before for connection to the deck interlock switch, while the two 12-pin connectors for the type 110 amplifiers are in the centre. Two polarised two-pin sockets are mounted at the far end for connection to the internal speakers.

WIRING DETAILS

The underchassis wiring is visible in the photograph, and should be made clear by the wiring diagram which we have prepared to aid the lesser-experienced constructor. All minor components are supported on either the resistor panel (miniature type) or on miniature tagstrips. It should be fairly easy to duplicate the original wiring using the photograph, circuit and wiring diagram as a guide.

One or two points should perhaps be mentioned in connection with the wiring. As with all audio equipment, the heater wiring should be carried out in twisted wires to minimise external fields. The wire used should be sufficiently stout to carry two or three amps without undue temperature rise (7-.010 nylex covered is quite satisfactory), and the heater wiring should preferably be done before the rest.

In wiring up the shielded cables for signal and bias/erase connections, follow carefully the wiring diagram concerning the shield braids. Deviations from the connections shown may cause hum, instability or bias injection into signal circuits, and are not recommended.

When soldering small components to tagstrips or the resistor panel, do not bend their pigtail wires too close to the body of the component or damage may occur. Also do not cut the leads too short (leave at least ½in), or the component may be damaged during soldering. If possible, use a pair of tweezers or pliers as a "heat sink" during the soldering operation, by using them to grip the wire between the component and the joint.

The output transformers may be provided with additional secondary winding taps, to suit other speaker mpedances. If it is desired to use internal and external speakers of other than 15 ohms impedance he wiring to the 12-pin and 2-pin sockets could be taken from the appropriate taps, the 15-ohm taps still being used for the feedback. If transformers having no 15-ohm secondary tap are used (perhaps because these are already possessed by the constructor), the feedback resistors at least will have to be ltered accordingly.

The feedback resistor value varies with he square of the impedance ratio, i.e., or a secondary impedance of half the value given (7.5-8 ohms) the resistors would be one quarter the value shown or approximately 1.8K. For a 3.75-ohm econdary the value would be approximately 820 ohms.

POSSIBLE TROUBLE

However, it should be noted that using other transformers may necessitate more modifications than just a simple hange of feedback resistors—different ransformer phase characteristics may equire the use of a feedback phasing apacitor and/or alteration of loop gain y modification of step circuits or feedack ratio.

The head connections, both for two-ead and three-head decks, were given ast month. Particular note should be made of the connection between the deck self and the amplifier chassis; if this not done operation will be plagued with instability and hum.

When the wiring is completed, the mains can be connected after the 110 mplifiers and speakers have been lugged in. If you are greeted with a oud scream from one or both channels fter warmup, switch off and reverse the utput transformer primary connections, s the screaming would indicate that e feedback polarity is positive rather han negative.

Providing the wiring and components re satisfactory, this should be the only ossible source of trouble and, if the eedback is correctly polarised, the ystem should be ready for immediate djustment and use.

As with the adapter power unit, the eater balancing pots should be set by rning up the replay gain controls and djusting the pots for minimum hum in e respective channels. Determination f the minimum can be done by listeng to the speakers or by connecting a TVM or millivoltmeter across the eaker leads.

Adjustment of the bias control should e done according to the instructions ven in last month's article. Briefly, the ea is to increase the bias to the point here the signal on the tape has peaked d fallen to about 0.8 of its peak value.

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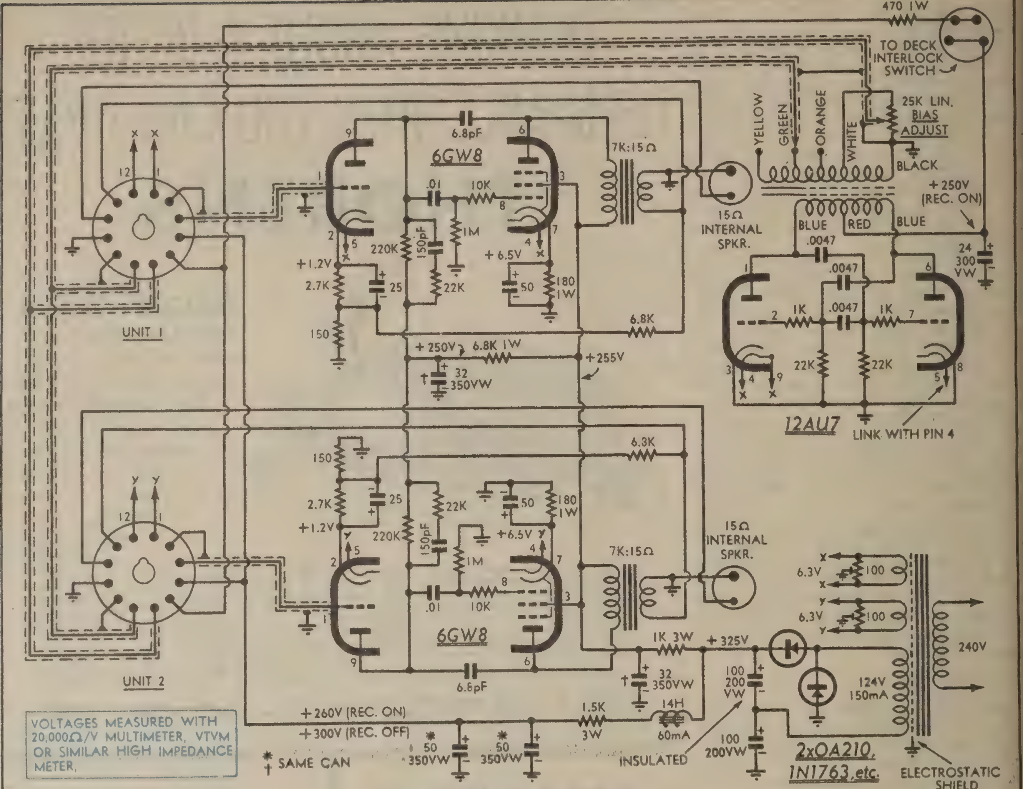
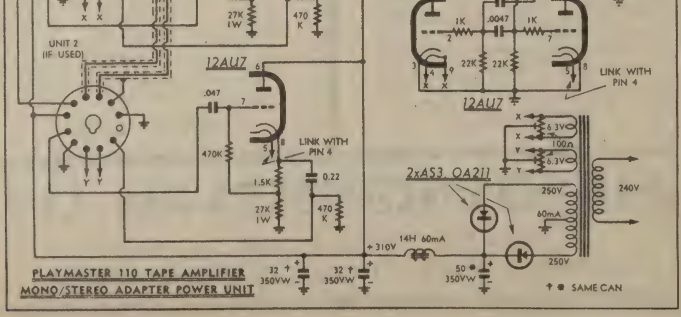


PLAYMASTER 110 TAPE AMPLIFIER
STEREO RECORDER POWER UNIT

Above is the circuit diagram of the Stereo Recorder Power Unit, which should be used in conjunction with the wiring diagram and underchassis photograph in constructing the unit. Below and on the facing page are reprinted circuit diagrams for the Adapter Power Unit and the Playmaster 110 amplifier unit, incorporating the modifications mentioned on page 62. All three circuits show typical circuit voltages.



PLAYMASTER 110 TAPE AMPLIFIER
MONO/STEREO ADAPTER POWER UNIT

Stereo Recorder Power Unit
PARTS LIST

1 Chassis, 11in x 9in x 1¼in.
1 Power transformer, 124V at 150mA, 2 x 6.3V at 3A, flat mtg.
2 Output transformers, med. quality, 7000 ohms SE to 15 ohms.
1 Filter choke, 14H at 60mA.
2 6GW8 valves, 1 12AU7 valve.
1 Bias osc. coil (see text).
2 Silicon pwr diodes type OA210 or similar.

RESISTORS (½ watt unless marked).
2 x 150, 2 x 180/1W, 1 x 470/1W 2 x 1K, 1 x 1K/3W, 1 x 1.5K/-3W, 2 x 2.7K, 2 x 6.8K, 1 x 6.8K/1W, 2 x 10K, 4 x 22K, 2 x 220K, 2 x 1M, 2 x 100 ohm slider pots, 1 x 25K LIN pot.

CAPACITORS
2 x 6.8pF, 2 x 150pF, 3 x .0047uF/-600V, 2 x .01uF, 1 x 24uF/350VW electro, 2 x 25uF/3VW electro, 1 x 32-32uF/350VW electro, 1 x 50-50uF/350VW electro, 2 x 50uF/-10VW electro, 2 x 100uF/200VW electro, one insulated.

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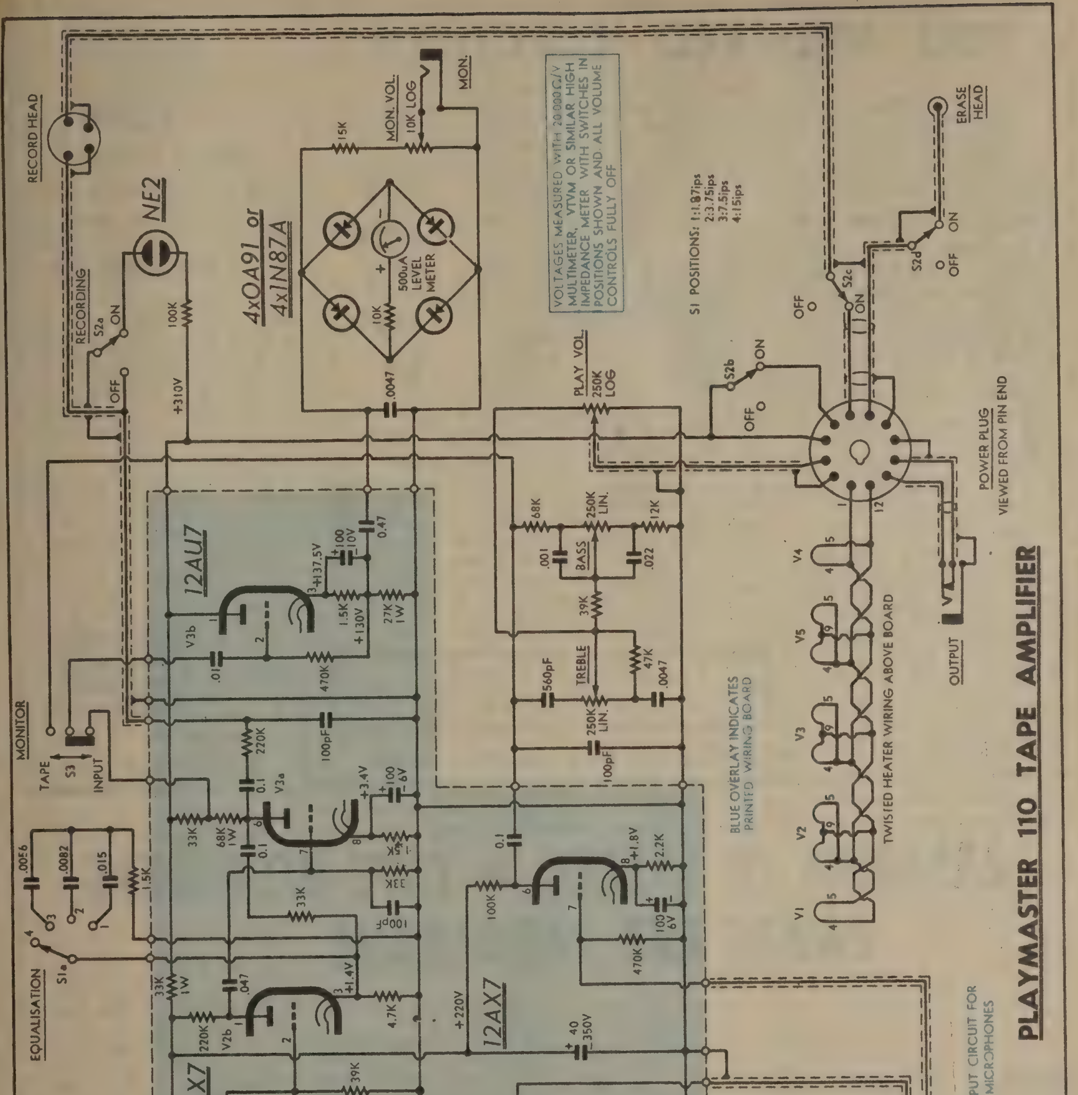
3 x miniature 9-pin valve sockets; 2 x 12-pin sockets, 2 x polarised 2-pin spkr. sockets and plugs, 1 x min. 4-pin socket and plug; 18-lug length of miniature resistor panel; 3 x 10-lug, 3 x 6-lug min. tagstrips; power cord and plug; nuts, bolts, grommets, etc.



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		119 IF valve	17/-
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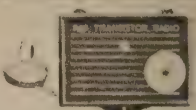

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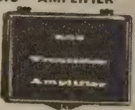

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APPENDIX—
Using the Playmaster 110 system with other decks

The Playmaster 110 Tape System while designed primarily for use with the "Brenell" tape deck may be used with other decks with appropriate modifications. Below are the changes required for the Collaro and Truvox decks.

FOR use with the Collaro deck the bias/erase coil circuitry must be altered as shown in the diagram. As the Michigan erase head is of fairly low impedance, it must be connected to the lowest tap (white) on the oscillator coil secondary, while the high impedance record head is connected to the top of the winding (yellow) via a series of 25K pot which acts as the bias adjustment.

The bias/erase frequency should be reduced to approximately 75KC by adding a .001uF/600V capacitor across the coil primary. The existing capacitors are not altered.

The changes required in the amplifier circuitry are as follows: To reduce bias injection into the replay circuitry during recording a .01uF capacitor should be shunted across the output of the replay preamp. This may be done at the "external input" jack, with the capacitor connected across the lead coming from the preamp.

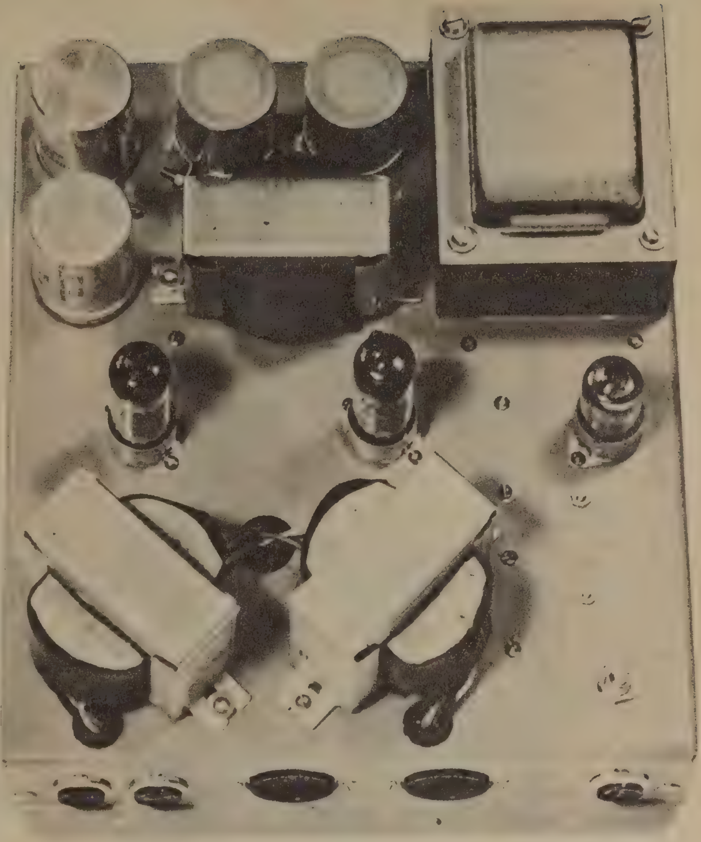
The monitoring switch recording signal tap-off should be altered to make the full signal available to the monitor by replacing the 68K/1W resistor on the board by a wire link, and changing the 33K resistor to a 100K/1W (plate circuit, V3a).

To make the equalisation more suited to the Michigan heads the equalisation capacitors should be changed as follows: The recording equalisation capacitors on S1a positions 1, 2 and 3 respectively should become .02uF, .01uF and .0068uF — position 4 is not required; the replay equalisation capacitors on S1c positions 1, 2 and 3 respectively should become .068uF, .047uF and .012uF.

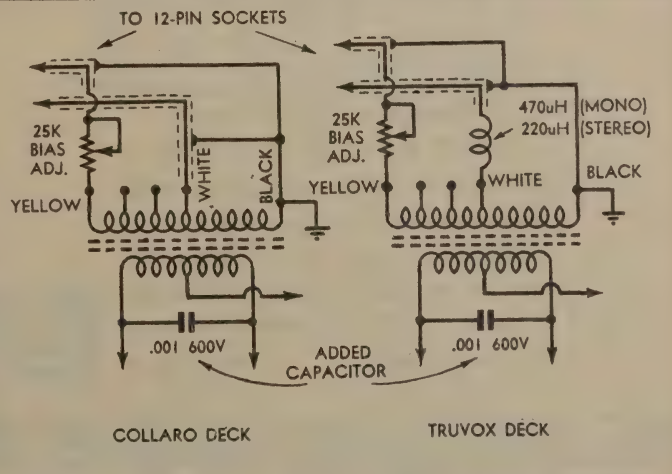
The changes in the bias/erase oscillator circuitry required for the Truvox decks are shown in the diagram. As may be seen the required connections are similar to those for the Collaro, apart from the use of an RF choke for reduction of the erase voltage. Again, a further .001uF/600V capacitor is connected across the erase coil primary.

With the Truvox deck a .02uF capacitor is required across the replay preamp to reduce bias injection (across the "ext. input" jack as before). Also the level meter multiplier resistor should be altered from 10K to 2.2K (do not alter the 68K and 33K resistors).

The only equalisation change required for the Truvox is the addition of a 68K resistor shunting the replay equalisation switch and resistors. The easiest way to add this resistor is to connect it between the rotors of S1b and S1c. ■



An above-chassis view of the Stereo Recorder Power Unit, showing the layout of the major components. The placement of the major components shown is discussed in the text. The diagram below should be studied in conjunction with the appendix at left, which discusses circuit modifications required for Collaro and Truvox tape decks.



FOR DETAILS OF CHANGES REQUIRED IN AMPLIFIER CIRCUIT, SEE APPENDIX.

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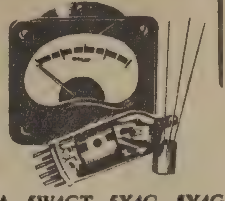


CHAPTER 21: Practical set construction.

Simple regenerative circuits. Salvaging parts from old sets. Types of power transformer. Resistors to control HT voltage. Alternate valve types. Sockets, pin connections and other valve data. Valve data books. Old type loudspeakers and modern substitutes. Physical layout and critical leads. Points about regeneration. Adjusting the coils. Coil details.

AS a change from the broader discussions which have characterised the last few chapters of this course, this chapter is devoted to essentially practical things. It is particularly aimed at our younger readers who, while keen to put theory into practice and build something for themselves, are often embarrassed by the cost of new components, and must make do with what they can acquire from discarded radios, from an older friend's junk box, or the disposals market.

We have therefore gathered together a selection of circuits from past issues which, either by design or by reason of the period from which they come, use those components most likely to be found on present day discarded chassis. With a little ingenuity, most of the major components may be used, and only a few shillings need be spent, mainly on minor components.

With simple receivers the most popular circuit arrangement is the regenerative detector (see Chapter 10) and, in this respect, all the circuits featured are basically similar. This simplifies coil details since a single set of data can be used for all the receivers. At the end of this article will be found coil winding details for coverage from the broadcast band through to 30MC with the receivers described.

In preparing this article we are mindful of the fact that some of the power transformers shown deliver considerably less voltage than most of those used on full size receivers. To overcome this difficulty we have included details which will allow the receivers described to use the transformers salvaged from discarded broadcast sets.

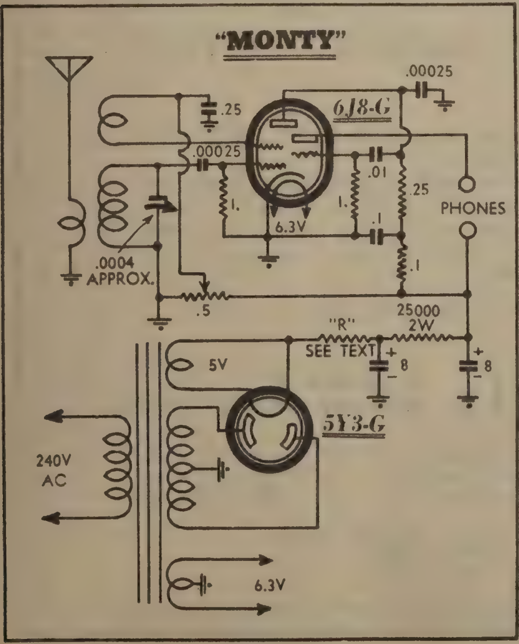
In many receivers the transformer used has only one filament winding and is used with 6X5GT and 6X4 type rectifiers. If your transformer has two or more filament windings then one can be used to power the filament of the rectifier, independently of the other valves in the receiver. In this case any of the following valves could be used as a rectifier: 80, 5Y3GT, 5Z4G, 5U4G, 5V4G, 5R4GY, 5AZ4, 5T4, 5DJ4, 5BC3, 5AS4A, 5W4GT, 5X4G, 5Y4G.

The first of the sets we present is "Monty," an interesting little receiver which appeared in the July 1945 issue of the magazine. "Monty" used a 6J8G valve which, at the time the article was written, was about the only triode/pentode available on the market. Today, there are a number of triode/pentodes available, many of which would probably work in this circuit with only minor changes.

Many of the disposals stores have available, at a very reasonable price, valves of the "loctal" base series. The type numbers of these valves mostly begin with the figure 7 and valve socket to suit them can often be obtained, also at a very reasonable price. The type 7J7 or 7S7 can be directly substituted for the 6J8G in our "Monty" receiver circuit.

In this respect it will be appreciated that the use of substitute valves, even where recommended for the circuit, usually presents the problem of pin numbers and socket connections. Since it is impossible for us to list all the possible variations on this theme, the reader will have to exercise a little initiative, and track down this information for himself.

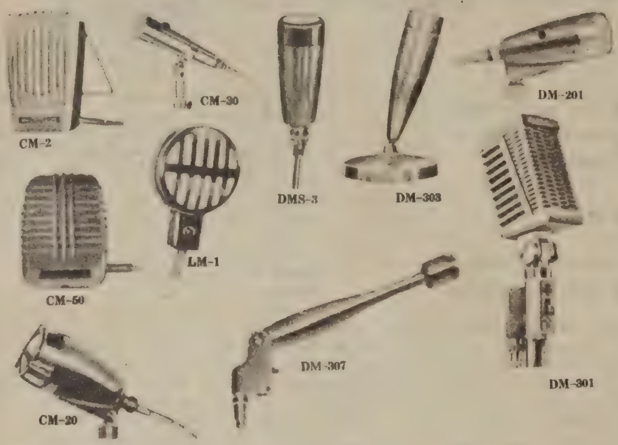
In fact, we imagine most followers of the course will, by now, have acquired some valve data books or sheets (Chapter 6). If not, then this is as good a time as any to start. Such information is normally available from local valve manufacturers either gratis or for a nominal charge. However, some of the more comprehensive books, both local



Our original version of this set. While a logical arrangement with new components, it need not be followed if salvaged components are to be used.

This circuit uses a 6J8 triode-pentode valve, with the pentode as the detector and the triode as an audio amplifier. It is about as simple a set as can be envisaged.

TEISCO MICROPHONES



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and imported, are a little more expensive, costing perhaps £1 or more. Considering the information they contain, and the value to the user for many years to come, they are well worth the cost. Two typical volumes are the "RCA Receiving Tube Manual" and "Miniwatt Technical Data." (See also page 71 September 1964 issue.)

Finally the matter of the power transformer. As shown, this circuit was designed for a transformer of around 150 to 200 volts (per side) but can be used with a larger transformer if a suitable resistor ("R") is included in the filter circuit. For a 250V transformer, "R" should be 2000 ohms, 1W. For 325V; 12,000 ohms, 2W. For 385V; 25,000 ohms 2W. The current drain in this case is so small that any transformer should be adequate.

THE "MINIVOX"

Another very popular little receiver was the "Minivox" which we featured in the December 1947 issue. This receiver uses 3 valves, including the rectifier, and will give quite respectable loudspeaker volume, particularly when used on the broadcast band for local station reception.

The 6V6GT power output valve in this circuit could be replaced with the loctal types 7A5, 7B5 and 7C5 and the 6SJ7GT with types 7V7, 7W7, 7L7, 7G7 and 7C7. Modern small 7 and 9 pin vales can of course be used and for this circuit we suggest a 6AU6 to replace the 6SJ7GT and a 6M5 or 6AQ5 for the 6V6GT. The 6M5 will need a cathode bias resistor of about half that needed for the other types.

If a 385V transformer is to be used a 10K-5 watt resistor should be used as in the previous circuit. A 325V transformer would need a 7.5K-5 watt resistor, and for a 250 or 225V transformer it would only be necessary to change the value of the cathode resistor on the 6V6GT to 470 ohms—all other values remaining the same.

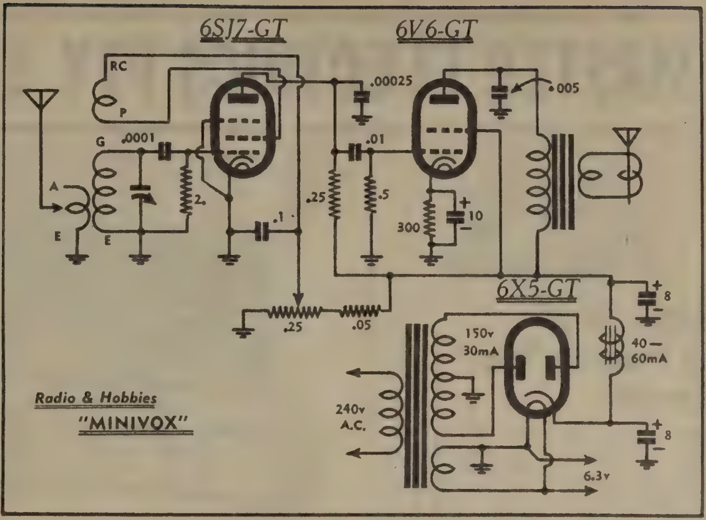
In the May 1950 issue we published our "50-Three," a small receiver which is, basically, no different from the "Minivox" except that it used the type EF50 valve. This valve is a very high gain pentode and was used by the hundreds of thousands in services equipment during the last war. We understand that these valves are still available at about eight for £1, so there is good reason to consider this particular circuit.

POWER OUTPUT

Although it was never designed to operate as a power output valve, the EF50 gives a good account of itself in this position and will provide good speaker volume on reasonable signal levels. The 20,000/3.5 ohm speaker transformer might be a little hard to obtain these days, but transformers having a lower impedance ratio could be used with some loss of volume.

If the "50-Three" is used with a 385V transformer a 12K-5 watt dropping resistor should be used. For a 325V transformer use an 8K-5 watt resistor and for a 250V transformer use 4.7K at 3 watts.

The circuit of this receiver, in common with many others in the article, was published before "preferred values" of resistors and capacitors were established. It will, therefore, not be possible to purchase many of the values shown on the diagrams and in this case the nearest preferred value should be used.



This set uses a conventional power output valve and so is quite capable of operating a loudspeaker in reasonable signal strength areas.

In the circuit of the "50-Three," for instance, a ".05" resistor (.05M or 50K—which ever way you like to look at it) would be replaced with a 47K resistor—this being the nearest preferred value. Similarly, the .005uF capacitors would be replaced with .0047uF units, again the nearest preferred value.

The next circuit we present is that of "Little Jim," a small receiver with quite a history and a name which will bring a smile of recognition to the face of many an "old timer." There are, today, many professional radio technicians who first "cut their teeth" on the "Little Jim" circuit.

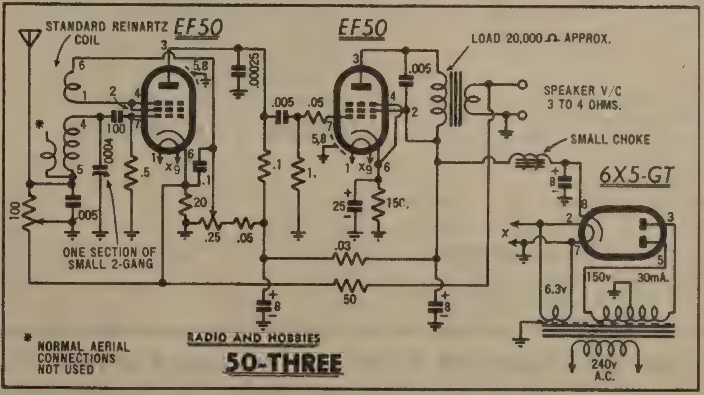
This receiver was originally featured in the very first issue of "Radio and Hobbies" (April, 1939) and such was its popularity, that it was revised, revamped and refeatured in many succeeding issues. The version we present in this article appeared in the May 1953 issue and was the last published version.

The receiver uses a twin triode valve in a regenerative detector—audio amplifier configuration and will give a good account of itself when used with high impedance earphones. The major difference between this circuit and the three so far shown is that it uses capacitive control of regeneration in lieu of the variable resistors used in the other circuits.

If desired, disposals valves such as the 6SN7GT and 6SL7GT could be used in lieu of the 12AT7. For use with a 385V transformer the series resistor would be 25K at 2 watts and for transformers of 325, 250 and 225V the resistor would be 18K, 10K and 8K respectively. These latter resistors should have a rating of 1 watt.

The last of the circuits we present is the "Basic Three" which was featured, originally, in our November, 1958 issue. This receiver was deliberately designed to make use of any "junk box" parts which might happen to be lying around or, alternatively, it could be put together from parts salvaged from an old broadcast receiver.

The rectifier valve in this circuit can be any one of the following: 80, 5Y3 (GT), 5Z3, 5U4-G, 83V, 5V4-G and 5R4-G. The rectifiers just listed are the ones most likely to be obtained from an old style receiver. All are intended to operate from a separate 5 volt winding



This set will also operate a loudspeaker, although the rather unconventional use of the EF50 as a power valve will limit the available power.

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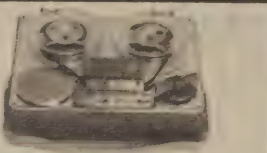

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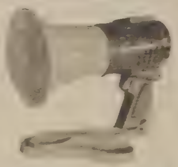
Price only: £2/15/3, plus 12½ per cent sales-tax. Total £3/2/2, plus freight.



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FREQUENCY RANGE: 540-1605 K c/s, 1.6-4.8 M c/s, 4.8-14.5 M c/s, 10.5-30 M c/s.
BAND SPREAD: 3.5 M c/s, 7 M c/s, 14 M c/s, 21 M c/s 28 M c/s.
SENSITIVITY: 10 uV (Input at 10 M c/s), S.N Ratio equals 20 DB.
SELECTIVITY: Variable from - 93 DB to 60 DB (Q-MULT in Operation with plus or minus 10 KC Detuning).
OUTPUT: 1.5 Watt.
POWER: 240 AC, 50 VA.
TUBE COMPLEMENT: 6BA6 RF AMP; 6BE6 MIXER; 6BE6 LOCAL OSC; 2X6BA6 I.F. AMP; 6AV6 2ND. DET. AF AMP and ANL 6AV6 Q'MULTIPLIER. BFO. 6AQ5 POWER OUTPUT. 5Y3 POWER RECTIFIER.
SPEAKER IMPEDANCE: 4 or 8 Ohms (Speaker not provided).
DIMENSIONS: Width 15 inches x Height 7 inches x Depth 10 inches.
WEIGHT: 20.5lbs.
AUX CIRCUITS: Band-Spread: Q-Multiplier: Automatic Noise Control.
AVC-MVC.
Phone Jack Plug.

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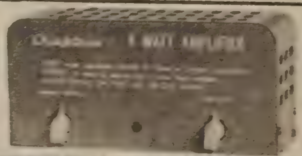

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Input Impedance—50.000 Ohms.
Output Impedance—15 Ohms.
Ideal for reproduction of records for P.A. work, either music or speech in small halls, factories, shops, garages, etc. Base is steel finished in grey hammertone with blue and white front panel and white knobs.

PRICE IS ONLY . **£12/19/6**

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Operates from 240 A.C. supply.

Will test all modern type tubes with miniature 7-pin minature 9-pin octal and Locter Sockets. This Tester will check filament continuity, short circuits in any elements and also omission. Overall size is 10in long, 8¼in wide, 3in deep. Meter size 3in x 3⅞in. Instruction and valve data sheets are in metal drawers at bottom of tester. A really compact job, ideal for portable use or on the bench. Weight 5¼lb.

Price is only £15 Plus 12½% Sales Tax.
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BRANCHES THROUGHOUT VICTORIA AND RIVERINA

on the transformer with the HT taken from one filament pin.

If you should happen to have on hand one of the more modern miniature rectifiers, such as the 6X4, 6V4, etc., they could be used provided the transformer has a 6.3 volt winding. This can supply one of the above mentioned rectifiers as well as the other valves, the HT being taken, in this case, from the rectifier's cathode pin.

RECTIFIER SOCKET

The rectifier socket, if salvaged from an old set, will most likely be of the wafer type and must be thoroughly cleaned before using. If there are any signs of breakdown or charring between the pins, the socket should be discarded. Cleanliness is important for the rectifier socket because it is subject to a considerable voltage and, together with the speaker socket, would be the first to break down if the insulation is imparied by charring or excessive dirt and soldering flux.

If the power transformer has a 2.5 volt filament winding on it (and many of the older types have only this voltage for filament windings) then type 59 or 2A5 valves could be used as power amplifiers. If the type 59 valve is used its third grid should be conected to the cathode.

If the transformer has a 6.3 volt winding then types 6F6, 6K6 and 6V6 could be used in the putput socket. All of the above valves will work in the circuit as is and require the speaker transformer to have a primary impedance of 5,000 to 7,000 ohms.

The loudspeaker shown on the circuit diagram is, incidentally, of the "electrodynamic" type, since this is the type most likely to be found on an old radio set. If the speaker you have on hand happens to be of the "permanent magnet" type it may be used by substituting a filter choke and resistor, in series, in place of the field coil. The choke should be rated at at least 50mA and from 10 to 30H, and the resistor should be of a value to make the total value (choke plus resistor) to 2,500 ohms.

Many of the older receivers used European output valves, notably the types EL3NG, EL33, EL33A and EL33B. These valves can be used provided the transformer has a 6.3 volt filament winding but the cathode resistor would need to be changed from the 470 ohms shown on our circuit to 150 ohms. Also these valves are sometimes prone to parasitic oscillation and may require the addition of a 10K resistor between their grid and the moving arm of the volume control.

A large number of valve types can be used in the detector socket of the receiver. Among the better known types are the 24A, 78, 58, 6C6, 6D6, EF39, 6U7, 77, 6K7, 6SK7, 6S7, 6J7, and 6SJ7. As with the output valve, they must be of a type requiring the same filament voltage as is available on the transformer and, of course, you will have to provide the right type of socket and appropriate connections to it.

All the circuits we have described call for a single section ("gang") tuning capacitor, and these are sometimes available quite cheaply from disposals and other sources. However, most old radio sets are fitted with a two gang capacitor, and there is no reason why these should not be used if they are on hand. Assuming that they are working correctly, it is simply a matter of ignoring one section.

The physical form which sets of this kind are likely to take will vary a great deal, depending on the whims of the builder, and the size and shape of the chassis, dial, power transformer, etc., which happen to be available.

Fortunately, most of the wiring in such simple sets is not unduly critical. The exception is the tuned circuit, and the leads to and between the tuning capacitor and coil should be kept as short as possible. This is most important at the higher frequencies.

The success of these simple sets is dependent almost entirely on the correct functioning and adjustment of the regenerative circuit. If the set does not regenerate it will have poor sensitivity and may appear not to be working if there are no strong signals around. It will also lack selectivity and, where there are strong signals present, these will swamp any weaker ones.

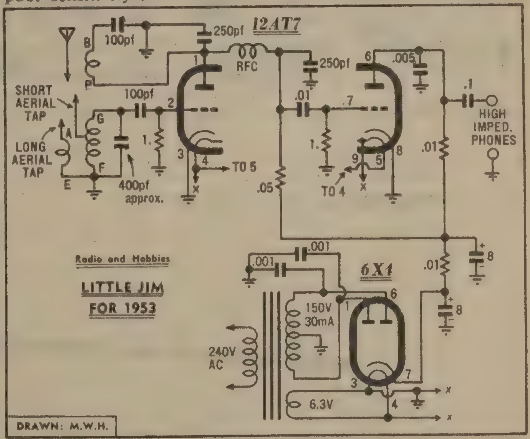
The regeneration must also be smooth so that it can be accurately set for best results. A set should "slide" into regeneration, never "plop" or "jump" in. It should also come out of regeneration at the same setting of the control at which it went in.

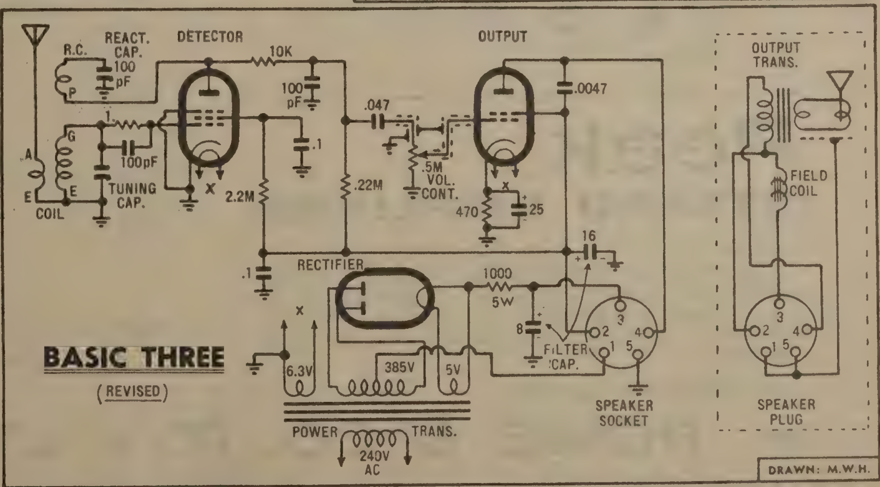
The regeneration winding on the coil has a great deal to do with this behaviour. If connected the wrong way round, the set will not regenerate at all. If too close to the secondary winding, or too large, regeneration will be fierce and difficult to control. If too far away, or too small, regeneration may not occur over part or all of the band.

Where a pentode detector valve is used, and the screen voltage is varied to control regeneration, there is a danger that the coupling between the regeneration and secondary windings may be too tight, making it necessary to reduce the screen voltage to a very low value in order to control the regeneration. This results in poor performance from the valve. If this is suspected, the coupling should be slackened until it is only just sufficient to ensure reliable operation over the band.

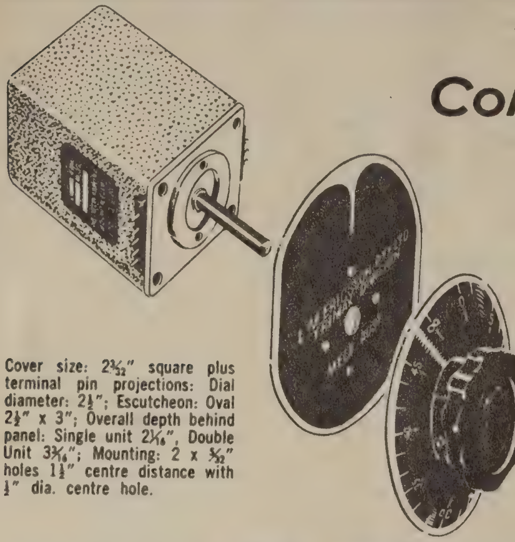
(Continued on page 75)

Another simple set, intended for earphone operation. The twin triode is unlikely to be found in a discarded set, but should be available cheaply through disposals. The rather unusual heater connections for the 12AT7 are to enable it to operate from 6.3 volts.





Another design for loudspeaker operation. This set was specifically designed to use parts salvaged from an old receiver, and will work with a wide variety of valves.



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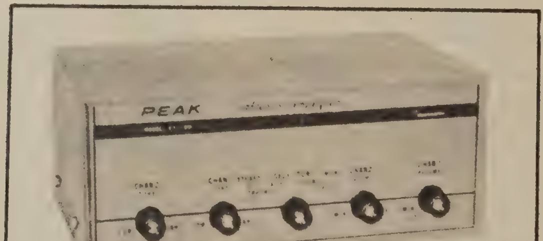
MODEL ST-100



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MAX. OUTPUT POWER: 10 Watts, 5 Watts per channel.
FREQUENCY RESPONSE: 50 to 15,000 cps
HARMONIC DISTORTION: Less than 2% at normal levels.
CROSSTALK AT 1 KC: Better than 40 db.
HUM AND NOISE: 40 db. below rated output.
INPUT (FOR FULL OUTPUT):
  Phono CER: 0.22 V, 100,000 Ohm.
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  Aux.: 0.15 V, 150,000 Ohm.
OUTPUT IMPEDANCE: 4, 8 and 16 Ohm (Each Channel)
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  Channel 1 with Power Switch and Channel 2.
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RADIO COURSE—Cont.

Coil Details for Small Receivers

DURING past years, hundreds of small sets have been described in technical magazines for home construction and there has been a wide variation in the design of appropriate tuning coils.

The accompanying data will be found suitable for nearly all small regenerative receivers, with or without an R-F stage. Formers should be of the usual 1¼in diameter, either ribbed or plain.

Exact coil requirements for any individual set are affected by associated components and reception conditions generally, so that a little experimenting will often result in vastly improved performance.

Thus, if a receiver proves in practice to be too unselective try the effect of reducing the number of turns on the primary winding and/or increasing the spacing between primary and secondary. This improves the selectivity at the expense of the gain. Increasing the number of turns and/or the coupling has the opposite effect.

With regard to the reaction winding: If the receiver fails to oscillate toward the low frequency end of the band, it may be necessary to increase the number of turns on the reaction winding and/or to move it closer to the secondary. If the reaction cannot be controlled properly, it may be necessary to remove turns and/or move the winding away from the secondary. If the reaction does not work at all, try reversing the connections to the reaction winding.

For reasonable coverage of the broadcast band, a tuning capacitor with a maximum capacitance of from 350 to 400pF (.0004uF) is required. The use of a smaller tuning capacitor would necessitate additional sets of coils, or, alternatively, switching in a capacitor in parallel with the tuning capacitor to cover the low frequency end of each band.

Thus when using a .00025uF capacitor, the high frequency portion of each band may be covered in the normal manner. To cover the low frequency portion, switch a mica capacitor of .0001 or .00015uF directly in parallel with the tuning capacitor.

The coil details given in the table are designed for use with a tuning capacitor with a maximum capacitance in vicinity of 400pF. The overlap is sufficient to allow for considerable variation in maximum and minimum capacitance.

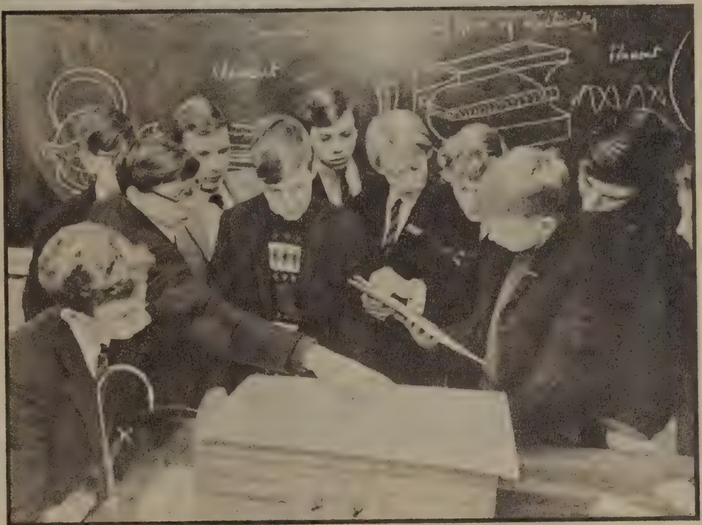
All coils are wound on 1¼in diameter formers, which is the most usual size for plug-in coils. For the sake of economy, only three popular SWG gauge enamelled wires are specified. Wires of slightly different gauge and/or with different insulation could be used, but due allowance would have to be made for the different space occupied by the coils and the resultant effect upon the inductance.

It is helpful to refer to wire tables, as given in the "Radiotron Designer's Handbook" and similar texts. Thus, 32 SWG gauge enamel will be found to occupy similar winding space to 29 or 30 B & S gauge enamel, or to 32 B & S gauge DSC, and so on. Wire requiring greater winding space may make the broadcast coil too long to fit on to the former.

The broadcast reaction winding must use fine wire to allow the required num-

BAND (With Trimmer)	BAND (Without Trimmer)	AERIAL PRIMARY	RF PRIMARY	SECONDARY	REACTION
1620KC to 550KC (Broadcast Band)	2MC to 570KC (Broadcast Band)	15T. 32 SWG Enam. Spaced 3/16in from earthed end of secondary.	Increase to 25 turns	100T. 32 SWG Enam. Close wound	40 - 60T. 40 SWG Enam. Spaced 1/8in. from grid end of secondary.
79 to 256 metres 3.85 to 1.7MC	64 to 255 metres 4.7 to 1.18MC	11T. 32 SWG Enam. Spaced 1/8in from earthed end of secondary.	Increase to 15 turns	38T. 25 SWG Enam. Close wound	20 - 35T. 32 SWG Enam. Spaced 1/8in. from grid end of secondary.
32 to 108 metres 9.3 to 2.8MC	26.7 to 103 metres 11.2 to 2.9MC	5T. 32 SWG Enam. Spaced 1/16in from earthed end of secondary.	Increase to 8 turns	13T. 25 SWG Enam. Spaced to occupy ½in.	9 - 15T. 32 SWG Enam. Spaced 1/8in. from grid end of secondary.
11 to 37 metres 27 to 8MC	10 to 36.6 metres 30 to 8.2MC	1T. 32 SWG Enam. Interwound from earthed end of secondary.	Increase to 3 turns	4T. 25 SWG Enam. Spaced to occupy ½in.	4 - 6T. 32 SWG Enam. Spaced 1/8in. from grid end of secondary.

ENGLISH SCHOOLBOYS' COMPUTOR



The schoolboys of form 3B, Litherland Secondary School, England, wanted a computer of their own. So, with the aid of their maths. master, 26-year-old Paul Beatty, they built one.

It is a simple machine, built in an old desk, and consists of 66 small light bulbs, a torch battery, many yards of wire, and other odds and ends. According to the master, programs are still being developed but so far it can multiply, test speeds, and do a couple of geometry calculations.

When a London firm of computer manufacturers heard about the experiment they were so impressed they sent a group of senior men to see the device. Subsequently the London firm treated the boys to a film show on computers and answered their many questions on the subject. The picture shows some of the boys at work with their computer while maths. master Paul Beatty looks on. He is fourth from the left.

Semi-Professional Tape Recorder

2-TRACK AND 4-TRACK STEREO AND MONAURAL

REVOX G36

The Revox G36 is a two-speed, three-motor, semi-professional high-quality tape recorder which will reproduce two- and four-track stereo as well as two- and four-track monaural.

The capstan is driven by a hysteresis-synchronous type motor with pole-switching to provide the two speeds. Spool sizes from three inch to 10½ inches can be used. The recorder incorporates an end of tape cut-off and rewinds 2,400 feet of tape in less than 80 seconds.

It features separate recording, play-back and erase heads. Remote control and pre-selected operating modes by push-buttons, or foot pedals, and all forms of Duoplay or Multiplay without accessories or bridging cables are possible.

There are three inputs per channel and each channel has a record level control by an individual VU-meter which is illuminated. Cathode follower outputs on each channel provide for amplifier, headphones or pulse coder for automatic slide projection. A built-in 6-watt monitor amplifier can be switched to each channel or used for feeding into a high-quality speaker system.

SPECIFICATIONS

These specifications apply to two-track as well as four-track recorders. Accessories are available upon request.

Tape Speeds:
7½, 3¾ ips

Speed Accuracy:
0.3% from nominal

Wow and Flutter:
± 0.1% peak reading weighted (DN45507)

Frequency Response:
40 — 18000 cps at 7½ ips
40 — 12000 cps at 3¾ ips
(+ 2, — 3 db)

Equalisation:
In accordance with IEC standards and DIN 45513
70 μs/3180 μs at 7½ ips
140 μs/3180 μs at 3¾ ips

Inputs per channel:
1. Microphone 3mV at 0.5 Mohm, Max 600mV
2. Radio 50mV at 1 Mohm, Max 10V
3. Aux. 3 - 50mV at 47 kohm

Line Voltages:
110, 125, 145, 220 and 240 Volts, 50 cycle

Power Consumption:
120 Watt

Weight:
Approx. 45 lbs.

Case Dimensions:
19 in. x 13½ in. x 12 in.

Harmonic Distortion:
(Overall 3% at peak recording level)

Signal-to-noise-ratio unweighted:
2 track recorder: 55 db
4 track recorder: 52 db at peak record level with 3% harmonic distortion

Dynamic range (Overall):
2 track recorder: 55 db at 7½ ips
53 db at 3¾ ips
4 track recorder: 52 db at 7½ ips
50 db at 3¾ ips
at peak record level (3% distortion)

Cross-talk:
Mono 55 db, Stereo 40 db

Oscillator bias Frequency:
70 kc/s, push-pull oscillator

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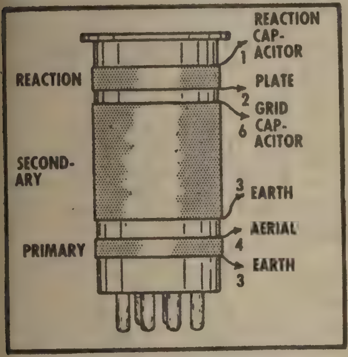
EP14-65

ber of turns in the small space at the grid end of the secondary.

Wire gauges for the other bands are less critical, since winding space is not a problem. However, the specification should be followed as closely as possible.

Unless otherwise stated all coils are normally wound in the same direction. The normal connections are as follows: Top of reaction winding to the "earthy" side of the circuit, bottom toward the plate or screen. Top of the secondary winding toward the grid, bottom to earth; top of the primary winding to the aerial or to plate, as the case may be, bottom to earth or to B plus.



The general style of winding for the low frequency close wound coils.

For simple receivers having no RF stage the coil will consist of an aerial primary winding, secondary winding, and reaction winding. The arrangement of the windings on the former is shown in the accompanying diagrams, the one on the right applying to most of the lower frequency band coils and that on the left showing the general style for the higher frequency bands where space winding and interwound winding is used.

In the case of a set using an R.F. stage there will be some re-arrangement of the various windings. The aerial coil will now consist of two windings only, one wound to the "aerial primary" specification and the other to the "secondary" details. The RF coil will have three windings, wound according to the "RF primary," "secondary," and "reaction" data.

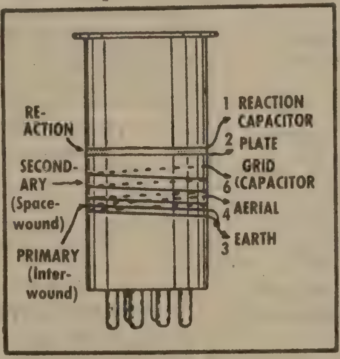
In order to ensure perfect tracking between the two stages each coil should have exactly the same inductance and any stray capacitance in either circuit will need to be balanced out by means of trimmer capacitors. Failure to match the two coils will cause poor tracking — and poor performance — at the low frequency end of the band and render it difficult or impossible to peak the trimmers at the high frequency end. Stray capacitance, if not corrected by means of trimmers, will cause poor tracking at the high frequency end of the band.

The presence of the trimmers across the coils will restrict the tuning range slightly and alter the coverage, so we have shown the coverage to be expected both with and without trimmers. Naturally there is no point in using trimmers where only a single stage is employed.

The coil former shown in the diagram is fitted with six pins which are designed to suit a standard six pin valve socket. This allows the required band to be selected by simply plugging in the appropriate coils. It is not particularly important what arrangement of pins is used for the various connections, providing they are the same for all the coils and the sockets are wired to correspond.

Where it is desired to provide one band only, such as the broadcast band, there is no need to use the plug-in type of formers and less expensive types, intended to be permanently mounted, may be used.

For reception much above 30Mc simple receivers are not very efficient and a somewhat different approach is required. The coil data also becomes more critical and dependent on the circuit wiring and layout. ■



The general style of winding for high frequency coils, showing spaced winding and interwound primary.

SERVICEMAN—Continued

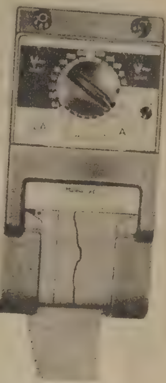
the HT. However, I didn't get that far. As I turned it over a pair of charred 1W composition-type resistors caught my eye. Sitting side by side and connected in parallel, they formed part of the HT filter network supplying all sections of the set except the plate of output valve.

A quick check confirmed my suspicions. They were both open circuit and there was no HT in that part of the circuit. Just why they failed is hard to say, except that the set designer might have been pushing his ratings a little in such a confined space. Assuming this was so, then the failure of one resistor would leave the second one to do an even harder job than before, thus hastening its demise.

The cure was simple enough. A new resistor—a wire wound 5W type this time—put the set back on the air in fine style. After a check to make sure that there was no excessive current drain that might have caused the previous failure, the set was ready to go back into its cabinet. Total cost: A few shillings worth of resistor and a minimum service charge, since the whole job had taken me only a few minutes.

Needless to say, the owner was delighted. And with good reason, for he now had a perfectly good set for about one tenth the expenditure he had contemplated.

But I'm still somewhat staggered by the incident, and I find it hard to understand the customer's strange reasoning. Still, that's people for you. ■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6AM6	7	6
6AL5	7	6
6J6	7	6
866A	15	0
813	£3/10/	
803	£3	
3A4	12	6
84/6Z4	12	6
12C8	12	6
1C6	12	6
1J6	12	6
3B7	10	0
3D6	10	0
304TH	£1/10/0	
2050	£1	
IK7	5	0
6J5	9	6
6J6	10	0
6J7G	7	6
KTW62/6U7	7	6
1D5	5	7
6F6	10	0
EF37	12	6
5U4G	12	6
6AG7	10	0
VT502	12	6
IL4	5	0
6K6	7	6
AV11	2	6
6K7	5	0
12SJ7	12	6
12SL7	12	6
6SH7	4	0
47	12	6
843	£1/10/0	
1629	5	0
1619	£1	
RK75	10	0
723A	£3	
VR75/30	15	0
RK84A	£3	
954	5	0
VR105/30	15	0
6AC7	7	6
2X2.879	5	0
6AJ5	5	0
VR150/30	15	0
6SA7, metal	7	6
12SJ7, metal	12	6
6N7	7	6
6AN5	12	6
CA19	£5/5/0	
5X4	10	0
6AK5	10	0
9006	5	0
6AS7	£1	
CK1013	15	0
EK32	15	0
809	17	6
EBC33	12	6
6AG5	9	6
EL91	10	0
EF73	4	0
EF72	4	0
EC70	4	0
2C26	7	6
RK34	7	6
IN5	7	6
1C7	5	0
1Q5	5	0
IM5	5	0
7C5	5	0
7W7	5	0
12A6	5	0
6C8	7	6
VR65	5	0
12SK7	5	0
IT4	10	0
6BM8	7	6
12BH7	7	6
12AU7	7	6
6BL8	7	6
6BX6	7	6
RL27	15	0
1616	7	6
5Y4	10	0
5X4	10	0
2A3	£1	
807	£1	
5U4	10	0
866	17	0
6X5	7	6
6SK7	12	6
6SS7	12	6
CV1136	7	6
CV1133	7	6
CV1102	7	6
5Z4	10	0
6SF7,	10	0
6SG7,	10	0
6F6,	12	6
829B and Socket	£2/17/6	
6BY7	7	6
1603	5	0
7N7	7	6
76	7	6
6G6	7	6
6B8	7	6
CV63	7	6
CV66	7	6
6SN7	7	6
6SJ7	9	6
12AT7	10/	
EF36	7/6	
EF37	7/6	
ECH 33	15/	
EBC33	7/6	
EF39	7/6	
6B6	7/6	
12BE6	10	0
6K6	7	6
6AR6	12	6
6BF6	10	0

GENEMOTORS

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12v	500v 350mA		£8	10	0
12v	1200v 200mA		£6	10	0
24v	250v 100mA	New	£2	0	0
24v	540v 200mA	New	£2	0	0
24v	300v 250mA	New	£2	15	0
12v	275v 110mA		£3	15	0

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325 x 325 150MA	4	15	0
285 x 285 300 MA	7	7	0
800V and 270V 300MA	7	10	0
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150 x 150V 30 MA	1	7	6
225 x 225V 40 MA	1	10	0
124V Doubler 300MA	3	7	6
130V Doubler 400 MA	3	17	6
145V Doubler 450 MA	4	17	6
150V Doubler 500 MA	5	7	6
220V Doubler 600 MA	7	7	0
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32V 240V 100 Watt	4	15	0

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1300 SPDT		7	6
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12 volts DPDT		12	6
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100 to 500 pf 3000v. var.		10	0
500 to 2000 pf 750v. var.		10	0
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400 ohm		12	6

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1mfd 3000V		17	6
.5mfd 5K, .1 5K, .1 3K AC .25 4K, .5 2½K ea.		15	0
4 mfd 3000	1	15	0
2 mfd 3000	1	5	0
1 mfd 3000	1	0	0
1.25 mfd. 6000v.	2	5	0
mfd 4000v.	1	10	0
2 mfd. 2000v.		15	0
4 mfd. 1500v.		15	0
1 mfd. 1500v.		10	0
8 mfd. 600v.		10	0
1 mfd. 1000v.		10	0

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2-way Vehicle Band Transceivers. Ex Taxi Cabs.
12 volt, 70 meg. Complete with valves and speaker.

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Air tested. Reconditioned with crystals to your frequency.

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VCR97	£1	17	6
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Radio Altimeter. V.H.F. 14 Valve. New Condition.

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Evershed and Vignoles. Megger type Units. To suit Auto or Aircraft industries

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27 lb. Vacuum. 7 CF. per min.

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240V — 110V 6 K.V.A. Transformers

Primary Taps. 220, 230, 240, 250.

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B.28—CR100

Current Navy Receiver
6 Band .40 K.C. to 32 Meg. Variable Selectivity. 2 R.F. 2 I.F. Stages. Crystal Gate Band Spread. New condition. Air-tested. Realigned 240V A.C. operation.

£65/-/-

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Air-tested, realigned. Perfect order.

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5 Band 650 K.C. to 30 Megs. 240 V. A.C. operation. Variable selectivity. Crystal filter. 2 R.F. stages. 2 I.F. stages. A late model receiver. Still in current use in Navy. Excellent selectivity and sensitivity. Air-tested. Realigned. Perfect order. Circuit included.

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A.W.A. version of National H.R.O. and A.R.7.

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4 Band, 500Kc to 30 Megs. B.F.O. S. Meter. Noise Limiter. Band Spread. 240v A.C.

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E.I.L. 62A

4 Band, Band Spread, Amateur Receiver. 9 Valves. 550Kc to 30 Megs, B.F.O. S. Meter. ANL.

£72/10/0

LAFAYETTE HE30

550 KC to 30 Meg.

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Built-in Crystal Calibrator.

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160 watt, 50 Cycle.
24v to 32v input.
Output can be supplied for 50-110 or 240v as required.
Suit radiograms, TV, Tape Recorders, Fluorescent Lights.

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450 Watt, as above.

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12 VOLT UNITS

240V. 50 Cycle. 160 Watt
Will Operate TV Sets.

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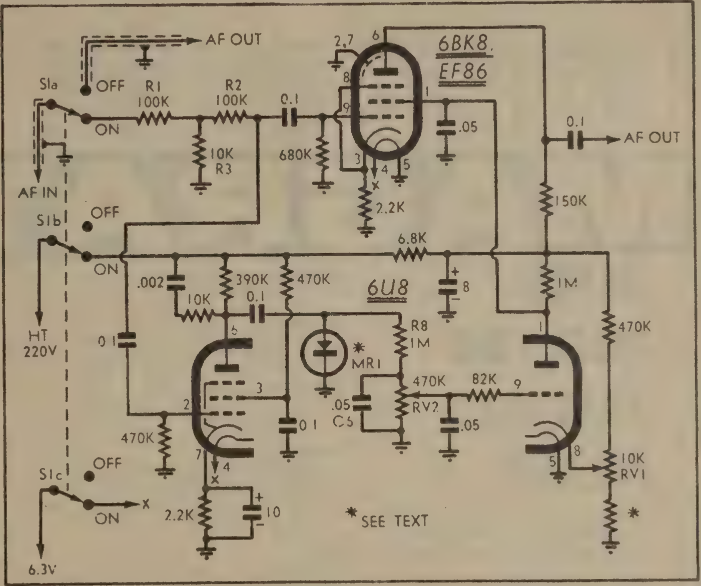
A READER BUILT IT!

Circuits and devices which we have not actually tested in our laboratory but published for the general interest of beginners and experimenters.

AUTOMATIC VOLUME EXPANSION CIRCUIT



With the availability of better records and pre-recorded tapes, there is less incentive, these days, to use automatic volume expansion to increase the dynamic range of recorded music. However, a letter from a reader in Port Moresby holds interest for those who may like to experiment along these lines. He writes:

"Enclosed is a circuit of a device which other readers may be interested in. The circuit is original and those interested must be prepared to treat it on an experimental basis.

"The idea has been in existence for many years, used commercially in one form or another. I wondered what the result would be, if applied to reproduced music in the home, so I decided to experiment and find out for myself.

"The simplest and most effective way, I thought, was to use the screen of an EF86 low noise pentode for gating. My next choice was a 6U8, the triode sections serving as a DC amplifier gating the EF86. The pentode section is used for amplifying the input signal, which is rectified and controls the grid of the triode section.

"The device works in the following manner: RV1 is set for the level where expansion is required to take place, giving the triode a certain amount of fixed bias. The input signal must reach a certain level before the fixed bias (cathode bias) is overcome by the negative volts produced by MR1. RV2 controls the amount of expansion.

"With the gate closed, about 5dB of gain from input to output is available. With maximum expansion it is about 16dB, far more than really necessary. My experiments were made with an audio oscillator, VTVM and a CRO and, after getting the device working to my satisfaction, I decided to try it out between my radio tuner and amplifier.

"The output of my tuner was peaking at RMS values of 0.5 volt or more, which is too much for the EF86 with the gate closed. About 0.25 volt is the maximum before the sine wave begins to flatten. For this reason I have included a voltage divider to the input R1, R2 and R3, as shown in the circuit, for readers who intend to try it in similar circumstances.

"With a certain amount of discretion in setting the controls, the overall result gives much colour and life to program music, but speech is better with no expansion. In the circuit I have included a switch so that it can be switched in and out of circuit according to requirements.

"The choice of MR1 is left to the builder, the limiting value being the peak inverse voltage rating, but I suggest also that one should be chosen with a good front-to-back ratio, to minimise shunting effect. RV2, C6 and R8 constitute a time constant, and RV2 should not be more than .5M. With the values used, the rise and decay times had no adverse overall effect on the function under listening tests.

"A resistor can be included in series with RV1 to limit the setting where expansion takes place, and this is left to one's own choice."

R. F. Clark,
C/- Post and Telegraphs,
Port Moresby, Papua.

ACOS MICROPHONES AND MICROPHONE INSERTS

MIC 39-1. The famous crystal stick microphone.

Frequency response .... 30-12,000 c/s.
Sensitivity .... 62 dB ref. 1 V/dyne/cm².
Recommended load .... 4.7 M Ohm for above response.
Price: £7/19/6.
MIC 39 DYNAMIC. With a dynamic insert. High and low impedance matching.
Frequency response .. 80-10,000 c/s. ± 3 dB, and approx. 10 dB down at 50 c/s. and 15 kc/s.
Sensitivity ...... Low impedance connection (nominal 200) 80 dB ref. 1 V/dyne/cm² on open circuit. High impedance connection (nominal 50k) 54 dB ref. 1 V/dyne/cm² on open circuit.
Price: £18/-/-.
MIC 38 INSERT. This insert is fitted to the MIC 39-1 and is available separately. Price: £4/19/6.

Sole Australian Agents:

AMPLION (A'SIA) PTY. LTD. 29 Majors Bay Rd., Concord, Sydney, N.S.W. Phone 73 1227

Victorian Distributors:
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Stentorian SPEAKERS

MODEL H.F.1016 STENTORIAN MAJOR. Designed to achieve full range response when mounted in a "compact" cabinet. Fitted with a curved, graded cone with radial and axial stiffenings which provide discontinuities in the surface reducing "cone breakup" and providing a rigid centre section which forms a high frequency radiator extending the response well into the upper register. This ensures a response free from distracting resonance.

Cone diam. 10in. Pole diam. 1in. Flux density 16,000 gauss. Total flux 64,000 maxwells. Impedance Coil at 15 ohms. Frequency response 60 c.p.s. to 16,000 c.p.s. in suggested cabinet. 30 c.p.s. to 16,000 c.p.s. in larger cabinet. Capacity 10 watts. £16/14/- (including Sales Tax).

Model H.F. 1016 Stentorian 10in. P.M. Unit, 16,000 gauss magnet. Universal impedance speech coil at 3, 7.5 and 15 ohms. Capacity 10 watts. Frequency response 30 c.p.s. to 15,000 c.p.s. Base resonance 15,000 c.p.s. Base resonance 35 c.p.s: £11/17/6 (including Sales Tax).

MODEL H.F. 1012 STENTORIAN 10in. Unit, 12,000 gauss magnet. Universal impedance coil at 3, 7.5 and 15 ohms. Capacity 10 watts. Frequency response 30 c.p.s. to 14,000 c.p.s. Base resonance 35 c.p.s. £7/10/- (including Sales Tax).

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FOLDS—
Angles from 175 deg. to 85 deg. 18in long.

FORMS—
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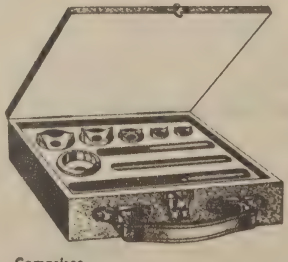

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Wooden Carrying Case . . . Reamer . . . Tommy Bar . . . 1-1/8in Die . . plus 5 Combination Die-cutters to suit 5/8in, ¾in, 7/8in, 1in, 1-1/8in standard valve sockets.

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(complete in wooden carrying case)

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Hand Operated NIBBLING TOOLS

This revolutionary Nibbling Tool by 'ADEL' cuts round, square or irregular holes and shapes to any size over 7/16in. and notches and trims undersized holes to fit points.

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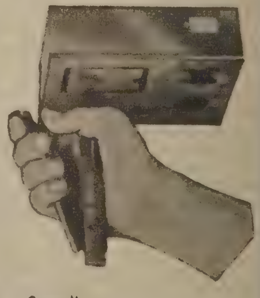

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Steel to 18-gauge, Aluminium or Copper to 16-gauge, punching Bakelite, Plastics, etc.

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AUDIO TOPICS

COMPUTERS AND MUSIC

Can we turn the computer into a universal musical instrument of uprecedented versatility and precision? In principle we can, but the present electronic unreality of the sounds that it makes, and also its daunting potentiality, forces us to re-examine the nature of music itself

by Dr. J. R. Pierce

Bell Telephone Laboratories, Murray Hill, New Jersey

THE application of electricity to the production, as contrasted with reproduction, of music goes back to the early years of this century, when an effort was made to bring signals from a primitive electric organ into homes over wires. This project was abandoned, partly because of the interference it caused to the telephone system.

With the invention of the valve and the development of the science and art of electronics, a number of electric musical instruments have come, and most of them have gone. The Theremin is no longer with us and the Novachord has vanished into limbo, but there are a surprising number of electronic organs in churches and in homes, and there have been lively experiments with more esoteric instruments.

Indeed, there are in all countries centres of electronic musical art, in which the squawks, squeals, and other outputs of electronic apparatus are mixed with reversed, speeded-up and otherwise processed natural sound, which are the basis of musique concrete.

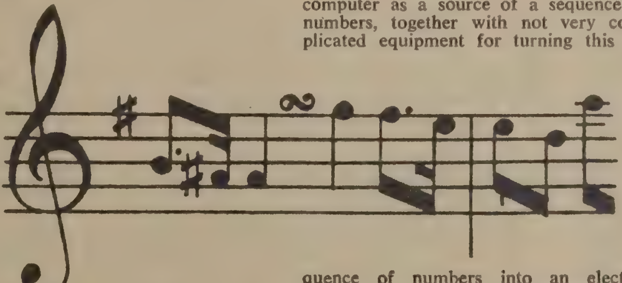
The proponents of electronic music have found themselves plagued with two chief problems. One of these has been the terribly time-consuming process of setting up equipment that generates or processes electronic sound and the hours spent adjusting and using the equipment and in piecing bits of tape together to achieve an over-all result. The other limitation has been one of variety of sound. However strange electronic music may sound, it seldom sounds anything but electronic

A great deal of skill on the part both of instrument makers and of composers, has gone into making conventional instruments and ensembles produce extremely various sounds. At the same time, however, the writer of music for conventional instruments is limited to the sounds which conventional instruments can be made to produce.

Another limitation which plagues the composer for conventional instruments is his reliance on the skill of the performer in executing his intentions. Haydn had instruments and an orchestra at his beck and call, but today's composer must often wait a considerable time for an experimental verification of the effect he conceives and intends.

As long as the maker of electronic music simply creates new but limited instruments, he suffers the limitations of all particular instruments, whether they be mechanical or electronic. He may or may not rely on a performing artist, according to the techniques he uses, but he certainly has not escaped challenges of manual skill and dexterity.

A partial escape is illustrated by The RCA music synthesiser, now in use by Milton Babbit and others at the Columbia-Princeton Electric Music Centre, which can be controlled by a punched tape.



The coming of the digital computer has, in principle, changed the situation. In 1936 the English logician, Turing, showed that a certain rudimentary type of computer, which we call a Turing machine, can compute any computable number. In simpler words, this means that a Turing machine can carry out any numerical process that one can specify explicitly.

While modern digital computers are not Turing machines and have limitations which the idealised Turing machine with its infinite memory, does not have, they are much more flexible and capable in a practical way than the machine Turing envisaged. In a very real sense, electronic computers are universal machines which can do anything that any machine can do. Limitations lie in the insight and skill of the programmer, not in the digital computer itself.

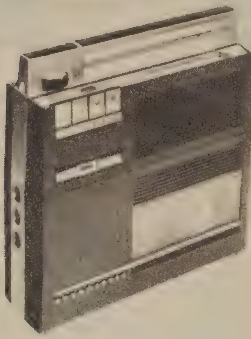
Digital computers produce numbers, not sounds. However, information theory which C. E. Shannon launched on its course in 1948, tells us, even in its most elementary aspects, that the world of messages is a universal world, amenable to numerical representation and interpretation. The electric wave which, by means of a microphone or a pickup, goes from an instrument or a recording into the speaker of a high-quality sound system can be specified with complete accuracy as a sequence of numbers. These numbers specify the amplitude of the wave at regularly spaced instants of time.

The number of numbers required per second is twice the bandwidth of the sound, or about 20,000 numbers per second for high-quality music· Furthermore, the numbers themselves need not be infinitely accurate, for the ear cannot detect small errors in amplitude. Thus, 20,000 three-digit numbers a second can describe not only any music that has ever been played, but any music that ever could be played if only we are able to choose the right numbers.

Here is a powerful resource. A digital computer as a source of a sequence of numbers, together with not very complicated equipment for turning this sequence of numbers into an electric wave that can drive a loudspeaker, is truly the universal musical instrument — the instrument which can, in principle, create any sound that can be created, any sound that can be heard by the ear. A composer equipped with a digital computer has no limitations except his own. But there lies the rub.

Over the past few years, workers at both the Massachusetts Institute of Technology and the Bell Telephone Laboratories have been experimenting with the digital computer as a source of musical sound. More recently, this work has been extended to Princeton University, and similar work is being carried on at the Argonne National Laboratory. Related studies of the analysis and synthesis of conventional musical sounds are being carried out at Yale.

What are the results? They are surprising and promising in some ways and discouraging in others. One discouraging aspect is that even the IBM 7094, which is a very fast computer, takes about five seconds to produce one second of



THE
TELEFUNKEN
MAGNETOPHON
300
PORTABLE TAPE RECORDER...

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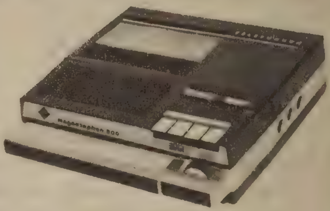

an experience in living sound

- The M300 is small, light and *truly* portable.
- All controls can be reached with one hand.
- A metal frame protects the vital parts even under the most adverse conditions.
- The tape-drive is unique. Two counter-rotary flywheels ensure constant tape speed even when the recorder is being swung about while walking.
- The M300 is completely independent of the mains power and can be driven by 5 flashlight batteries or one rechargeable "Dryfit" storage battery. It can also be connected to the mains or driven by the car battery, through accessory adaptors.
- The push-pull amplifier stage may be switched off when using an external amplifier, thereby conserving battery life.
- It has no conventional on/off switch. All operational controls switch the recorder on, and the "stop" button switches it off.
- A special loop catch ensures tape loops caused by motion are absorbed and straightened out.
- The amplifier board is hinged and the tape recorder still operates when it is swung out—an advantage that service technicians will appreciate.
- The pause button is located in the carrying handle and can easily be operated with the thumb of the carrying hand.

TECHNICAL INFORMATION:

Tape speed: 3¾ ips. *Track arrangement:* Half track. *Max. reel diameter:* 5 inches (up to 3 hours' playing time). *Frequency range:* 40-14,000 cps. *Signal to noise ratio:* ≥ 46 dB. *Wow and flutter (weighted):* ≤ ± 0.3%. *Distortion:* ≤ 5%. *Connections for:* Radio, microphone, pick-up, external speaker, earphones, ext. power supply, 10 transistors, 1 rectifier, 6 pushbuttons. Control for level and volume. *Level control:* VU-type meter, Built-in perm. dyn. speaker 2¾" x 4". *Power supply:* 5 flashlight cells or TELEFUNKEN "Dryfit" storage battery or Mains/recharger unit for 110-127-220-240 Volt A.C. 50-60 cycles, or connection to car battery (6 or 12 volts) with car adaptor lead. *Weight:* 6¾ lbs. approx. *Dimensions:* 10¾ x 3 x 10⅞" approx.

PRICES:

M300, TD-7 microphone, 5" LP Tape, Empty Spool, Audio lead, **£114.9.0.**

ACCESSORIES:

Reporter Microphone TD300 with built-in VU & input level control	**£18.11.3**
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music. Time on the 7094 costs several hundred dollars an hour. This is a limitation that will be overcome as computers become faster and more economical.

The other discouraging aspect is that, while the sounds produced are often wild and weird, they lack the richness which we are accustomed to hear in conventional instruments, and more especially in large ensembles of instruments. Something is missing and, while we can guess at its nature, we cannot point to it in a precise and quantitative enough way so that we can tell the computer to produce the effect we seek.

Helmholtz made great strides in musical acoustics in the 19th century, but the science has not progressed at the same rapid pace as others. The user of a computer is free to specify the wave form or frequency content of the sound he produces; he can make these random or regular in any degree; he can introduce regular or random vibrato. He can control the "attack" and the duration of the notes. But, unlike the composer who has used a symphony orchestra as one huge instrument, he has neither years of tradition nor the skill of instrumentalists to rely on.

A little experimentation shows clearly that while the harmonic content or frequency spectrum of the note has a strong influence on its quality, the attack has an even stronger influence. A rapid rise and gradual fall gives a plucked quality to a sound. A moderate rise, a sustained sound, and a moderate fall simulates a woodwind quality. A vibrato enhances the musicality of the sound.

However, many things escape us. The brazen summoning of the trumpet is not easily evoked. Massed strings or voices must gain their effect through some degree of randomness in pitch or in attack. Yet, introducing randomness into computer music in simple ways makes it sound merely wobbly or noisy, rather than rich.

In all, the user of the computer is in somewhat the position of a musically talented savage when confronted with a grand piano. Certainly, wonderful things can come out of this box, but how is one to bring this about? Tuition, intuition and practice are required, but there is no teacher and no one to guide the practice.

We are faced with an intriguing challenge. In principle, the computer can become the universal musical instrument. All that stands between us and all that was previously unattainable is an adequate grasp, scientific and intuitional, of the relevant knowledge of psycho-acoustics.

Both by experimentation, and by careful measurement and analysis of musical sounds, we must find among the bewildering complexity of the world of sound what factors, what parameters are important, and in what degree, in achieving the effects at which we aim, all the variations of sound that we hear from a skilled instrumentalist, all the characteristic sounds of instruments, the rich massed sound of the orchestra, and everything that can possibly lie beyond these familiar elements of music.

Men who are scientists or engineers only will never solve this problem. Its solution can come only through co-operation between those who understand something of the mechanism of hearing and psycho-acoustics, those who understand the use of computers, and those who have real musical talent and creativity.

Here is a chance for fruitful co-operation between science and the arts, rather than the phoney invocation of scientific formulae and jargon which so often satisfies artists in the present.

It is heartening to know that the work at Princeton and at M.I.T. is carried out in the departments of music, by people who are musicians and who are knowledgable about computers, and who have the full co-operation of computer-oriented people.

It also heartening to know that the computer study of the analysis and synthesis of musical sounds which is being carried out at Yale is supported by a grant from the National Science Foundation.

The worry which is so often raised about the status and support of the arts in our society seems, in this instance, to be met. If good art can embody a valid contribution to good science, then art can validly share, not only the fruits of science, but the support which society so rightly gives to science.

For other accounts of this subject see:

M. V. Mathews, J. R. Pierce and N. Guttman, "Musical Sounds from Digital Computers," Gravesano Blatter, Vol. 6, Nos. 23 and 24 pp. 115-125, 1962.

M. V. Mathews, "The Digital Computer as a Musical Instrument," Science, Vol. 142, No. 3591, pp. 553-557, 1963.

J. C. Tenney, "Sound Generation by Means of a Digital Computer," Journal of Music Theory, Vol. 7, pp. 25-70, 1963 (Yale University).

Music from Mathematics, Decca Record DL9103. ◘

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Recently a glaring example came to our notice of a so-called Playmaster Bookshelf unit being sold which had an obsolete single-cone Rola tweeter, underfelt packing and a badly fitted back — each item contrary to our specifications. Needless to say, the unit performed badly.

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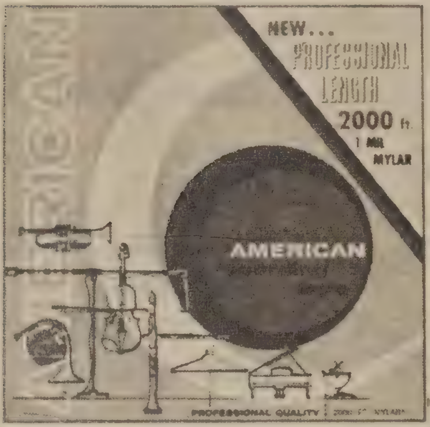

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Classical reviews

By JULIAN RUSSELL

HINDEMITH — Sonatas number 1, 2, 3

Hindemith—Sonatas Nos. 1, 2 and 3 for Piano. Eric Heidsieck. Record Society Stereo 6142.

Whatever your opinion of the emotional quality of Hindemith's work there is no gainsaying his proficiency as a craftsman. These sonatas, which date from 1936, show all his usual virtues of lucidity, energy and a fund of melodies, some commonplace and many of unusual length.

The longest of the three, the first, is a formal structure, its chief interest for me lying in its exploitation of changes in rhythm and metre. Despite its indubitable expertise I liked it least of the three.

The brief No. 2 I found much more palatable. In it Hindemith unbends enough to offer movements of genuine charm. By the way, when you listen to this you had better ignore the label. This lists only three movements, whereas there are four. What is described as the slow last movement is, in fact, the third, while the unmentioned fourth is a delicious little rondo.

Ravel, of the "Tombeau de Couperin," receives a tribute in the first movement of the third sonata, which, I suppose, is as good a way as any to say that it is derivative. The second movement is in the form of a sweetly pompous little march. The Finale offers a typical Hindemithian fugue, busy, good-natured, skilfully assembled, relapsing now and again into well-contrasted seriousness.

Heidsieck plays them all deliciously with crisply accurate articulation, his carefully shaded pianissimos making his well-controlled fortissimos all the more piquant. The sound is both lifelike and pleasing. This is a disc that should interest all pianists with a taste for contemporary composition.

* * *

Strauss—Don Juan. Tod und Verklarung. Vienna Philharmonic Orchestra conducted by Lorin Maazel. Decca Stereo SXL6134.

This is a young man's performance of a young composer's work. The boundless energy of the music of "Don Juan" is exploited by Maazel with admirable discretion that contains it without taming. His vigor is never allowed to impair the sensibility of his phrasing or firm control of dynamic variations. And the engineering reproduces with the utmost fidelity and richness of tone the many details in Strauss' heavily embossed scoring.

There is one section, though, that I found disappointing. The first long oboe solo is sentimentalised in a way that reminded me of Stokowsky at his naughtiest. The tone droops, the phrasing is flacid, and both faults acquire added prominence from the clean-cut virility of the surrounding passages.

I noticed, too, that fine though the sound is, the Vienna Philharmonic's usually luscious-sounding string section acquires here a quite alien wiry quality. But this can be forgiven in view of the added clarity awarded the more heavily scored sections.

In contrast to the youthful ebullience of "Don Juan," "Tod und Verkalrung" opens in a veritable sick-room atmosphere. Its fever is not that of an erotic hero but of an exhausted old man awaiting death. And in this the offending oboe of "Don Juan" abandons his sentimentality and phrases everything exquisitely.

The accuracy of attack and release are continuingly impressive. And I found Maazel's open air treatment of the "Redemption" theme a pleasing change from the gooily pious shape it can sometimes assume. The sound again is excellent, thought I thought the engineer might have made a little more of the climax where Strauss, in the score, directs the trombones to lift the bells of their instruments and blast out directly at the audience.

Here they remain almost sedately within the framework of their surroundings.

* * *

Brahms—Complete Piano Works Vol. 2. Capriccios and Intermezzos, Op. 76. Capriccios and Intermezzos, Op. 116. Julius Katchen. Decca Stereo SXLA6118.

This volume continues on the same high level of achievement as the first of Katchen's integral recording of Brahm's piano works, reviewed here a few months ago. In this program the fine pianist has never played better. His outlook remains fresh in even the most hackneyed of the works. Thus, in the well-known B Minor Capriccio, his style is beautifully "semplice" but never simpering, and he is careful not to make too much of the contrasts between the outside and middle sections.

The only minor point of criticism I can make about the whole disc is that there is a tiny bit of crowding in the fast bits in the D Minor Capriccio, the last in Op. 76.

No student, or even accomplished performer, should be without these superb examples of Brahms playing, to my mind easily the best at present available on any label. The sound is of winning fidelity.

* * *

Mendelssohn—Quartet in A Minor, Op. 13. Quartet in D Major, Op 44, No. 1 Juillard String Quartet. Epic Stereo ELCS9110.

The reconstructed Juillard Quartet seems to be concentrating more on eighteenth and nineteenth century music than the original, which won outstanding renown for its performances of contemporary music. Here the players lend the full complement of their virtuosity to these two works which, whatever their minor failings, remain imperishably fresh under such treatment.

The fast movements are miracles of fleet precision, the slower ones masculine and unlanguishing. These quartets have remained strangely neglected since about the end of World War I when Mendelssohn became the target for the sneers of the then avant-garde groups. In fact, very little Mendelssohn has been played during the past 30 years if one excepts the "Midsummer Night's Dream" music and, in England, provincial performances of "Elijah." His piano trios, however, have always remained popular with chamber music students.

Of the two works presented here, I prefer the early A Minor Quartet, composed when Mendelssohn was only 18. It offers an interesting example of cyclic form which must have caused quite a stir when first heard. It is a more spontaneous work than the better-known D Major, which is probably the most popular of the six he eventually wrote.

The sound is admirable though there are passages when the leader seems to retreat unaccountably behind the second violin. This does not seriously impair the performance, but it gives an odd sound to the balance at times. The players, this time, are the same as those in the Juillard's delicious recording of Mozart quartets reviewed in this column with great enthusiasm a few months ago.

* * *

Wagner—Overture "Die Meistersinger"; "Faust" Overture; Introduction to Act Three, "Lohengrin"; Overture "Flying Dutchman"; "Rienzi" Overture. Pittsburgh Symphony Orchestra conducted by William Steinberg. Command Classics Stereo CC11020SD.

A glance at the selection will show Wagnerities that all the pieces on this disc, with one exception, belong to Wagner's early and middle period. The earliest is "Rienzi," his first successful opera, though the "Faust" Overture was completed round about the same time. To me, this latter is the most interesting item on the disc. It is never played nowadays in the concert hall and those curious enough to study it must have resource to the score.

Designed originally as the first movement of a "Faust" symphony, it later became a tone poem, possibly the very first of its kind of any importance. With its completion in Paris, in 1840, Wagner abandoned symphonic composition to

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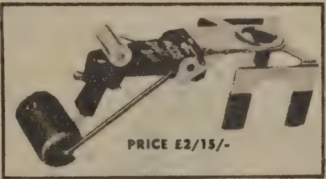

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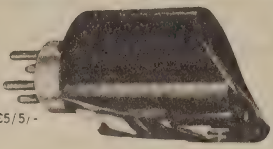

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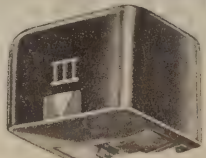

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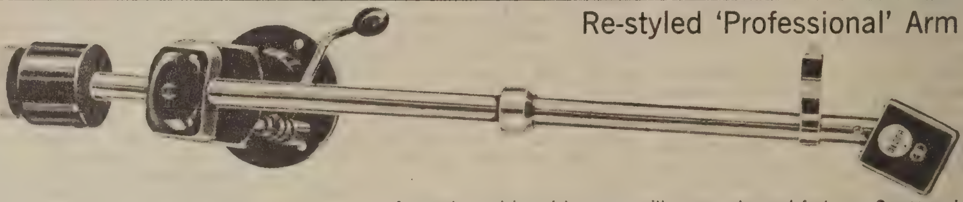

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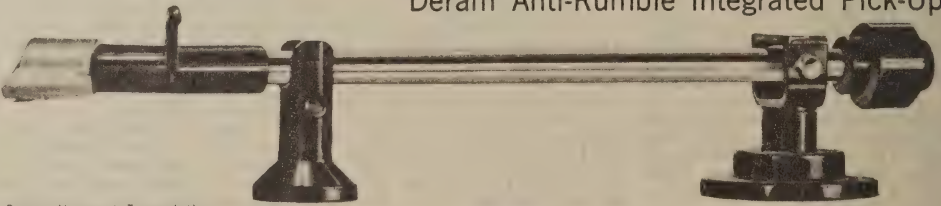

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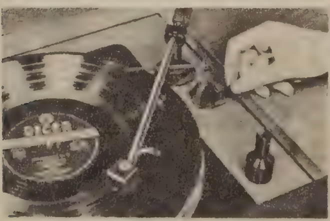

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devote all his time to opera. He did, of course, compose the short "Siefried Idyll" at a very much later date for a special occasion, one or two dreadful marches and a handful of short piano pieces in between.

Wagner keeps more or less to sonata form in the "Faust" overture, though his treatment suggests Liszt's theme transformations rather than the developmental practices of Beethoven. More interesting than the construction is the thematic material. Much of it is derivative, though, even when he pays tribute to his predecessors, it is always with a strong streak of originality. You can enjoy foretastes of "Tannhauser" "Lohengrin," and in one theme, note for note, the "Tristan" motive from the very first bar of that opera.

This material is very freely worked over with more than a hint of Liszt in the method, though this must be one of the only times that Liszt borrowed from Wagner and not vice versa. The orchestra plays it very well indeed. In fact, they play the whole program excellently, the only disappointment being in the opening bars of the "Meistersinger" Overture which, though intended to sound pompous, here sounds laboured.

Steinberg takes the opening and closing sequences of the "Lohengrin" Third Act Prelude very fast indeed, imparting an unusual and effective glitter to the music. The other pieces all receive skillful attention. As is usual with these smaller American companies, many extravagant claims are made on behalf of the engineering. In this one the company puts a long spiel on the sleeve vaunting its improvement over all other techniques. Actually the engineering is very brilliant but, in the manner of earlier American recordings, somewhat hard and brittle.

* * *

Walton — Concerto for Cello and Orchestra.

Bloch — Schelomo for Cello and Orchestra. Gregor Piatigorsky and the Boston Symphony Orchestra conducted by Charles Munch. RCA Stereo LSC2109.

The engineer here has granted Piatigorsky such virtuoso preference that important orchestral passages are often obscured by the closeness to the mike of the solo instrument. In a work where the orchestral part is less worthy of full attention this would not have mattered very much, but in both these concertos the orchestral part is often as significant as the soloist's and the ensemble suffers in consequence.

True, Piatigorsky's playing is of a standard that provides enjoyment of every bar, but, as Zsa Zsa Gabor once said in another context, "This is too much." Although the work cannot be classed among the composer's most successful, especially the third movement which gets around clumsily on a broken skeleton, its presence in the catalogue is welcome to all students of the composer's music and to all cellists with the technique to play it. It is, indeed, the first recorded performance I have heard, though others might have existed back in the days of 78s. It was, by the way, commissioned by the present soloist, Piatigorsky.

"Schelomo" is a passionate work offering Bloch in his Old Testament mood of exhortation, warning and reverence. His music in this vein always call to my mind the paintings of Rouault. It calls for jagged climaxes fraught with menace, and wailing passages reminiscent of Jewish liturgical cantillation. You will find them all here — when not impeded by the cellist, who, I am sure through no fault of his own — he is much too fine an artist to insist on such prominence in these works—sometimes comes between you and the admirably played orchestral part.

* * *

Rachmaninoff—Piano Concerto No. 2 in C minor, Op. 18. "Rhapsody on a Theme of Paganini." Gary Graffman and the New York Philharmonic Orchestra conducted by Leonard Bernstein. CBS stereo SBR235103.

These two works have been recorded so often, and frequently so well, that another version appears, on paper, redundant. But a few minutes listening to either side of this disc will explain why I welcome it so enthusiastically. The standard of playing by both Graffman and the orchestra and the perfection of the engineering are such that this new one must be placed right up among the best ever made. Especially good is the recording technique which never fails to maintain a perfect balance between soloist and orchestra at whatever dynamic level either or both might be playing.

Then again though the works are at present out of favour with anti-romantics —though certainly not with the public—both Graffman and Bernstein give themselves up without any restraint but that of good taste to Rachmaninoff's luscious, if epigonous, writing. They may play "molto espressivo" but they never become maudlin.

Technically all the playing is beyond criticism. In neither work did I hear a bar that I would have preferred to be different. The pianist's fast passages never falter, his slow ones are always beguilingly lyrical. The orchestra never fails to give exemplary support where it is needed and to assert itself just where, and how, the composer wanted it to.

* * *

A French Program—Artur Rubenstein (piano). "Valses Nobles et Sentimentales" and "La Vallee des Cloches" (Ravel) "Mouvements Perpetuels," Intermezzo in A Flat, and Intermezzo No. 2 in D Flat (Poulenc); Nocturne in A Flat (Faure); Scherzo-Valse (Chabrier). RCA Stereo LSC2751.

There seems to be no end to Rubenstein's versatility. His repertoire includes every major concerto ever written, most of which he can play without even a cursory reference to the score. He has established himself as one of the greatest Chopin players of all time. His Beethoven is never less than impressive. And I once heard him give a marvellous account of a piano version of Stravinsky's "Petrouchka" specially transcribed for him by the composer.

Here he is in different mood, perfectly attuned to the refinements and sensuous appeal of the French composers of this century. By the way, he spent much of his youth in France, speaks French like a 16th arrondissement Frenchman, and was a friend of many of the composers whose works he plays here. He was, of course, born in Poland but at present shares his time living in Paris in a house on the Avenue Foch, and in an apartment in New York.

Ravel's "Valses Nobles et Sentimentales" is dimensionally the biggest work on his present program. It is composed of short pieces in 3/4 time, contrasted as the title suggests, though which of them are noble and which sentimental I have never been able to decide. The spectacular feature of Rubinstein's interpretation is the manner in which he relates them all subtly so that the work never sounds merely episodic but presents a formal pattern of great beauty.

His approach to the second Ravel piece, "La Vallee des Cloches," is much more impressionistic, in the Debussy manner, as is the music. Indeed this is the closest Ravel ever came to Debussy's style in any of his compositions. Here Rubinstein's concern is not so much with line as with sensitively contrasted harmonies and sonorities and he produces a tone from his instrument obviously inspired by Debussy's wish that his piano music should be played as if the piano had no hammers.

The serious poetic content of Faure's Nocturne in A flat is exquisitely realised with sentimentality resolutely avoided but never at the expense of warmth. Chabrier's exhilarating Valse-Scherzo provides the disc with just the right ending. Throughout the whole recital Rubinstein, despite the strength of his personality, deliberately effaces himself at the service of the music. There is no virtuoso grabbing of the limelight. It is all exquisitely French—and exquisitely Rubinstein.

* * *

Mahler-Symphony No. 9. Berlin Philharmonic Orchestra conducted by Sir John Barbirolli. HMV Stereo ASD 596/7. (3 sides).

The sleeve notes make much of the Berlin Philharmonic's enthusiasm for Barbirolli's performance of this symphony with them in Berlin a year before it was recorded. It was in answer to a request from the orchestra to record it with them that the present version was made. Listening to it one can understand the orchestra's eagerness to repeat it under Barbirolli. His reading is always warm, and in terms of the length and complexity of the work, unusually impulsive.

For instance, he obtains the maximum "schmaltz" from every phrase as it comes up, irrespective of what might happen to it later in the score. There is no grand plan of presentation as in the case of Bruno Walter's fine account for CBS. Symphonic argument seems to matter less than the extraction of every ounce

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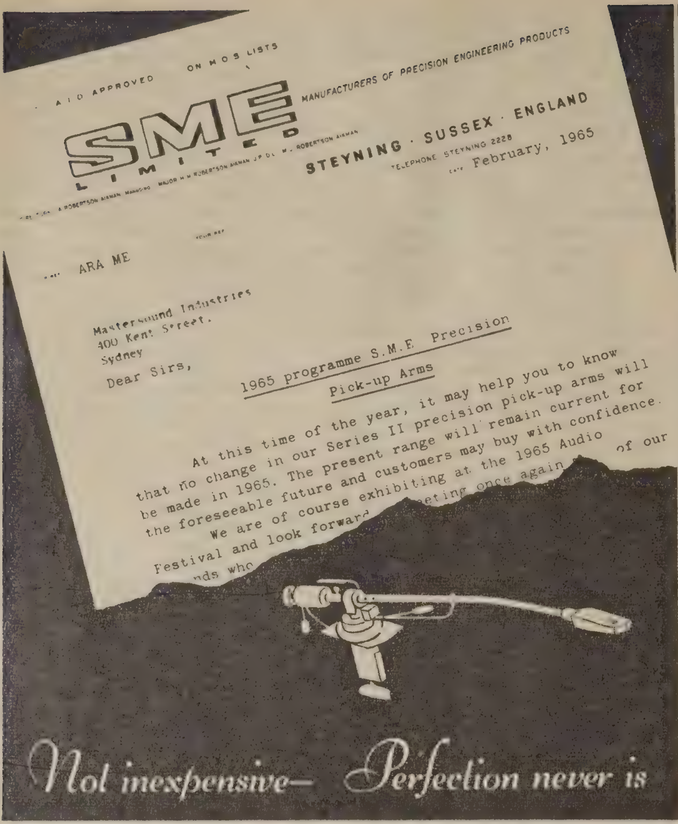
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of emotion from the luscious score. But though he never fails to push the music to its dramatic extremes there is no gush. It may be heady but it's not by any means tipsy.

Despite the stylistic purity of Walter's reading I prefer Barbirolli's in the two inside movements. Barbirolli's "landler" is much lighter-footed than Walter's who sometimes shares Klemperer's views on this matter. And in the Rondo-Burleske Barbirolli wins a bitter cynicism that is alien to Walter's make-up. But Walter's playing of the first movement and the Finale have a spaciousness that Barbirolli's lacks, perhaps because they are more truly symphonic in outlook.

In the matter of sound I prefer CBS clarity, which exposes every nerve in the score, to HMV's thicker acoustic. Mahler never got around to his stated intention of rescoring the Ninth with the object of giving it that marvellous transparency only he could obtain from so vast an orchestra. But what he didn't do himself CBS engineers—and Bruno Walter—go a long way to doing for him in their admirable recording.

However, with my preference for two of Barbirolli's movements and two of Walter's I am unable to recommend one of these fine performances at the expense of the other. The choice must be yours. But you can't go far wrong with either. Both have their virtues—and shortcomings.

* * *

Chopin-Waltzes (Complete). Arthur Rubinstein (pianist) RCA Mono LSC2726.

Here is a definitive recording of these graceful pieces, played with the utmost sensitivity and refinement of touch and phrasing. It is Chopin playing at its very best, elastic in rhythm, the sonorities beautifully and subtly contrasted, the articulation faultless in its easy perfection. Despite the disc's many competitor's, this is the best existing performance I know. I enjoyed again, with renewed enthusiasm, pieces I have known since childhood. I can imagine no better turning up in the foreseeable future.

* * *

Schubert—Quintet in C major, Op. 163. Jascha Heifetz and Israel Baker (violins) William Primrose (viola); Gregor Piatigorsky and Gabor Rejto (cellos). RCA stereo LSC2737.

This magnificent performance has till now only been available as one of three boxed discs issued some two years ago under the title of The Heifetz-Piatigorsky Concerts. No one record could be bought separately. Now anyone who does not wish to invest in the other two—though I can assure them that all are well worthwhile owning—can buy the quintet. It carries my very warmest recommendation.

RECOMMENDED

Bellini—La Sonnambula Highlights. Joan Sutherland; Margreta Elkins; Nicola Monti; Sylvia Stahlman; Giovanni Foiani; Fernando Corena. With the chorus and orchestra of the Maggio Musicale Fiorentino conducted by Richard Bonynge. Decca stereo SXLA6128.

Mozart—Clarinet Concerto in A major. Bassoon Concerto in B flat major. Gervase de Peyer (clarinet) and Henri Helaerts (bassoon) and the London Symphony Orchestra conducted by Anthony Collins. Decca Ace of Clubs mono ACL240. ■

DOCUMENTARY RECORDS

By Ellis Blain

GREECE IN MUSIC AND SONG: Argo (Mono) DA 29.

This is a most difficult record to assess. Everything about it is excellent, but the problem is how to describe it so as to give the potential buyer a clear picture of what he will get for his money.

Let me begin with the technical aspects . . . These are exceptional for a recording made in the field and virtually single-handed. Probably 50 per cent of this is due to the superb performance of the little Nagra 1B recorder used by James McNeish who collected the material. This Swiss made Nagra is in the very forefront of professional miniature portables.

The other 50 per cent is due to remarkable "know-how" on the part of Mr McNeish in his handling of tape machine and microphones. Open air acoustics can be very tricky—a trickiness which is accentuated by the virtual impossibility of effective monitoring while a "take" is in progress.

As to the music, it is absolutely authentic and representative of a large area of northern Greece with no concessions to Western taste. Sometimes strident, it nevertheless often delights with lovely, liquid sounds of unexpected orthodoxy. The general impression, though, is essentially Eastern, which is only to be expected in a country that was under Turkish domination for 400 years.

The Notes are colourful and evocative, usually describing the performers, the location where the recording was made and the scene at the time. A most unusual record which should have a strong appeal for anyone with a taste for the truly indigenous or the excitingly bizarre—or simply for the ever-increasing group of Australian Hellenophiles.

★ ★ ★

WINSTON CHURCHILL, THE MEMORY OF A GREAT MAN. RCA (Mono) LM2723.

As television viewers will have observed, the current trend in documentaries produced in the United States and Canada is toward a strong story line with marked dramatic development, together with a judicious mixing of actuality with basically authentic scenes which have to be re-enacted as no recording of them exists. This approach is in marked contrast to the more literal attitude toward documentary which concentrates on actuality, linked by narration, allowing the story to develop without help or hindrance from deliberate dramatisation.

Let me hasten to add that this "audio biography," as it is called by William Allan Bates, who wrote the script, is American documentary at its best. The treatment is dignified, authentic, thorough and truly moving. It is also most listenable. Of necessity, much of the story was prepared well in advance.

In the words of N.B.C. executive vice-president William R. McAndrew, "No sooner does a man achieve prominence than some news researcher is assigned the task of writing his obituary in advance—an eminently practical if somewhat gaunt and sombre honour accorded to the great." Basically, this was N.B.C.'s obituary for Sir Winston but, to quote McAndrew again, "an obituary in this case was not quite enough. For this man was something different. And his story was rather more than the story of one man, huge though he may have been in wisdom or in courage or in folly."

The story gains from the fact that it is an American view of one of the greatest Englishmen of all time. There is an impartiality which somehow makes the beloved and revered figure more human, more real. The narration is by N.B.C. news correspondent Chet Huntley. It is superbly written and splendidly delivered.

To tell so much of the Churchill story so well in so short a time is an achievement of which N.B.C. and R.C.A. can both be proud.

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HAMLET. FAMOUS SCENES FROM SIR JOHN GIELGUD'S PRODUCTION. C.B.S. (Mono) BR235092.

The pattern of recording Shakespeare seems to be settling into the established pattern for recording opera. First you issue the play complete on several L.P. discs then, a few months later you issue a single record with highlights or scenes from the original.

In the case of opera, the pattern has many advantages. Not everyone can afford the complete set and, again, by no means everyone wants the complete set. But how does it work out with Shakespeare? Are isolated scenes from a play sufficient to hold the interest? Has such a record any advantage, other than cheapness, over the original?

I can only suggest answers to these questions; obviously it is impossible to be empirical in a matter which depends so much on individual circumstances and preference. But two factors must have considerable bearing on the final decision . . . How effectively are the excerpts chosen and how well equipped are you personally to fill in the gaps . . .

In the case of this Gielgud "Hamlet," the selection and editing has been carried out with taste and sensibility.

Most of the great scenes are here but, of necessity, many have had to be omitted. How could it be otherwise with what, almost certainly, is the most interesting if not the finest play ever written? I should not think that anyone who has seen "Hamlet" or read it recently would have any difficulty in filling in the missing scenes.

As to the performance . . . Undoubtedly, Richard Burton is a Hamlet of considerable significance while Gielgud's production received almost universal acclaim from the New York Press.

You may find the American accents irritating and incongruous in places. I did. But the spotlight is on Burton whose accent is above suspicion while "His Prince of Denmark is forceful, direct, unpretentiously eloquent, more thoughtfully introspective than darkly melancholy, with the glint of ironic humour and decidedly a man of action and feeling"—New York Post. ■

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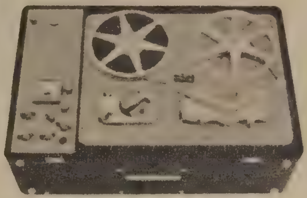

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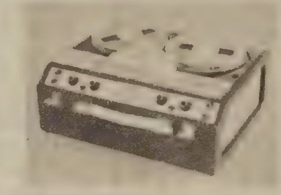

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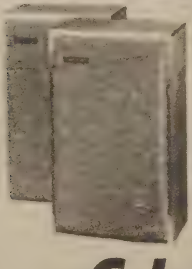

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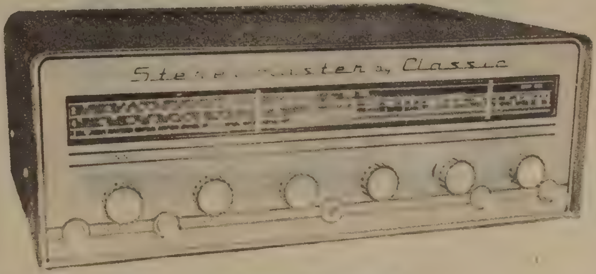

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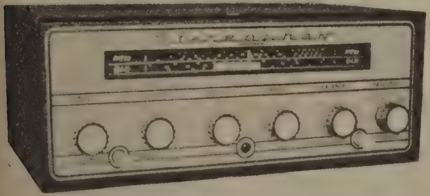

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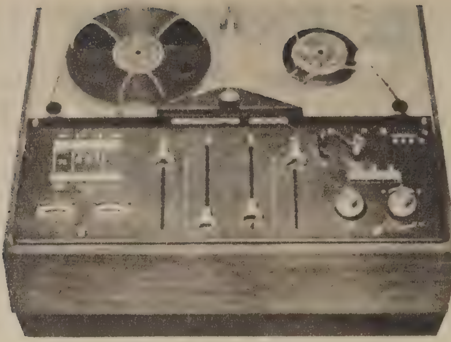

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Interest: Gospel songs.
Performance: Characteristic.
Quality: Normal.
Stereo: Normal.

It would take more than mere listening to establish whether, in fact, the Gospel songs here presented are "the best of George Beverly Shea." Nor is there any clue as to when and where the items were recorded.

I would judge that they are of fairly recent vintage and recorded, for the most part, with professional backing rather than with Crusade choirs and the like. In this matter, the jacket notes unfortunately offer no asistance.

Be that as it may, the whole presentation is in the familar Bev. Shea pattern, revealing a voice that is perhaps not as young as it used to be, but a conviction and a sincerity that remain undimmed.

Whether you buy this record or another, as a memento of Bev Shea's most recent Australian visit, remains primarily a matter of preference in regard to the song titles: "Blessed Assurance," "Deep River," "On Jordan's Stormy Banks," "Until Then," "How Great Thou Art," "Somebody Bigger Than You And I," "Sweet Hour Of Prayer," "Holy, Holy, Holy," "In Times Like These," "Bless This House," "Rocked In The Cradle Of The Deep" and "The Love Of God."

As noted above, the quality is to normal standards, including two numbers electronically reprocessed into stereo. (W.N.W.)

* * *

MAC WISEMAN SINGS BEST-LOVED GOSPEL HYMNS. Arranged and accompanied by the Jordonaires. Mono, Dot (Festival) ZL-31536.

Interest: Hymns in western style.
Performance: All right in its class.
Quality: Normal mono.

Mac Wiseman, a seasoned performer in folk, country and western style music, made this disc, so the story goes, to commemorate his tenth year as an artist with Dot Records.

As you might expect, it's in typical "western" style and with backing from guitar, electronic organ and the Jordonaires' vocal group.

If you like your hymns in western style, then Mac Wiseman is worth a hearing. If you don't, then I doubt that his efforts will change your opinion. He sings:

"Peace In The Valley," "Let The Lower Lights Be Burning," "I Heard My Mother Call My Name," "Bringing In The Sheaves," "Where Is My Boy Tonight," "Beautiful Garden Of Prayer," "Beautiful Isle Of Somewhere," "In The Sweet Bye And Bye," "If I Could Hear My Mother Pray Again," "Shall We Gather At The River," "Lord I'm Coming Home," "Tell Mother I'll Be There."

A disc with sectional appeal. (W.N.W.)

* * *

SINGING TOGETHER (Like We Did Back Home). Mary Jayne And Polly Johnson With The Dick Bolk Singers, Directed By Jim Owens. Mono, Word (Gospel Film Ministry) W-3300-LP.

Interest: Gospel songs.
Performance: Good.
Quality: Normal mono.

In the March issue, I strongly recommended a solo album by Polly Johnson, reportedly the only solo devotional disc she recorded before being killed in a tragic plane crash. I happened to notice this present one in the GFM display, presumably made before the solo album, in which Polly duets with her close friend Mary Jayne.

The notes point out that the two girls come from very similar backgrounds, both having been professional musicians before diverting their talents to spiritual ends. Their voices are certainly remarkably alike and it's not immediately evident who's singing what part.

To me, this disc doesn't have quite the polish of the one reviewed earlier but it's a good one, nevertheless, and well worth a hearing. Mary and Polly sing:

"I'll Never Be Lonely," "A Place That I Know," "I'll Be Somewhere Listening," "The Haven Of Rest," "Since I Be-lived," "Night Watch," "Down The Sawdust Trail," "Previous Memories," "His Hand In Mine," "The Ninety And Nine," "What A Precious Friend," "Whispering Hope."

As I said, well worth a hearing. (W.N.W.)

* * *

SACRED HAWAIIAN MELODIES. Bud Tutmarc, Guitar; with Mark Davidson, Pipe Organ. Mono, Word (Gospel Film Ministry) LP-8022.

Interest: Hawaiian guitar.
Performance: Competent.
Quality: Normal mono.

At a Saturday night Gospel rally, an Hawaiian steel guitar, generously amplified and well played, is a sure-fire hit, both for accompaniment and as a featured instrument.

But, taken out of context, robbed of the visual and "exposed" for 12 numbers in a row, the instrument rather tends to wear out its welcome.

Bud Tudmarc, friend and protege of the late Sol Hoopii, another Gospel artist, is not short on technical skill and employs a couple of novelty techniques by way of variation. One is a tension type vibrato which, unfortunately, drops the pitch more than it raises it, producing (to me) an intolerable flattening of pitch in "Whispering Hope." The other is apparent manipulation of the volume control to eliminate the transient altogether and present each note or chord as an entity which builds and decays almost symmetrically—a most unusual, if synthetic, sound.

Perhaps I should mention that support is provided by Mark Davidson on pipe organ but he doesn't get much of a look in. The titles:

"My Beautiful King Of Kings," "The

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Lover Of My Soul," "End Of The Trail," "He Hideth My Soul," "After," "When They Ring The Golden Bells," "Be Ready," "Hold My Hand," "Nail-Scarred Hand," "One Master," "No One Ever Cared For Me Like Jesus," "Melody Divine."

To sum up, this is a record which you should hear for yourself. Depending on your viewpoint, it could entertain, intrigue or make you swear off steel guitars for the rest of your life! (W.N.W.)

FROM STAGE AND SCREEN

LOVE SCENE. Elmer Berstein conducts music from the great romantic films. Dot (Festival) 12-inch stereo, SZ LP 931,535. Also on mono, ZL-31,535.

Interest: Movie themes.
Performance: Smooth.
Recording: Excellent.
Stereo Quality: Good.

For those without a "singing strings" type big-band record of romantic film themes, this would be a good choice. Elmer Bernstein and an unnamed orchestra play warmly and smoothly a dozen well-known and fondly evocative themes, making very pleasant listening indeed.

The themes are "Gone With The Wind," "Around The World In 80 Days," "Spellbound," "Love Is A Many-Splendoured Thing," "For Whom The Bell Tolls," "Lili," "Raintree County," "A Streetcar Named Desire," "Laura," "A Place In The Sun," "Broken Arrow" and "The View From Pompeys Head."

Technically the disc is excellent, with very low noise, indiscernable distortion and good tonal balance. The stereo is wide but unexaggerated.

Recommended for pleasant listening anytime. (J.R.)

* * *

THE SOUND OF MUSIC. Music and lyrics by Richard Rodgers and Oscar Hammerstein II. Original sound track album starring Julie Andrews and Christopher Plummer. Stereo, RCA LSO-2005.

Interest: Popular musical.
Performance: Excellent.
Quality: Mostly good.
Stereo: Good definition.

After a run on Broadway of 1,442 performances, there is no need to speculate about the appeal of "The Sound Of Music." The success of this film version by 20th Century-Fox, starring Julie Andrews and Christopher Plummer, seems assured.

It is a warm, human story of a young novitiate, too unconventional and too spontaneous to fit into the ordered pattern of convent life. Instead, she becomes governess to the family of the widowed Baron Von Trapp and gradually humanises his rigid naval outlook on family life by introducing "the sound of music."

Later, the musical accomplishments of the family group provide the means whereby they escape the Nazi net which encompasses their Austrian homeland.

Included on the two sides are "Prelude," "Overture," "Morning Hymn and Alleluia," "Maria," "I Have Confidence In Me," "Sixteen Going On Seventeen," "My Favourite Things," "Climb Every Mountain," "The Lonely Goatherd," "The Sound Of Music," "Do-Re-Me," "Something Good," "Processional and Maria," "Edelweiss," "So Long, Farewell," "Reprise."

The recording generally is excellent, with Julie Andrews performing just as you would expect. However, some may be disappointed with the Mother Abbess' song, "Climb Every Mountain," admittedly not an easy one to sing, but not as smooth and true here as it might be. Then, there are a couple of tracks on side 1 that have more tape background than one expects these days.

But these minor criticisms shouldn't be magnified overmuch. It's an enjoyable disc from a most enjoyable show. (W.N.W.)

* * *

FIDDLER ON THE ROOF. Book by Joseph Stein, music by Jerry Bock, lyrics by Sheldon Harnick. Original Broadway cast album with Zero Mostel, Maria Karnilova and Beatrice Arthur. Stereo Dynagroove, RGA LSO-1093. (Also available in mono).

Interest: New musical.
Performance: Competent, spontaneous.
Quality: Very good.
Stereo: Seldom bettered.

"Fiddler On The Roof," a new musical and the fifth from the team of Jerry Bock and Sheldon Harnick, traces the fears and fortunes of a tiny Jewish community in Anatevka, an impoverished village in Czarist Russia.

Tevye (Zero Mostel) a pious dairyman, has five daughters who should, by tradition, have married men chosen for them by their parents. But true love intervenes and, before it, tradition has to yield as gracefully as it can. And tradition receives a further blow when it becomes evident that the community must break up and seek freedom to live and worship wherever they can find it. And, for Tevye, the land of hope is America, no less.

The whole atmosphere is very human and I can well understand the "New York Times'" verdict, quoted in the notes, ". . . filled with laughter and tenderness."

Zero Mostel is the foundation character on which the show is built but other members of the cast provide him with excellent support.

The track titles: "Tradition," "Matchmaker," "If I Were A Rich Man," "Sabbath Prayer," "To Life," "Miracle Of Miracles," "Tevye's Dream," "Sunrise, Sunset," "Now I Have Everything," "Do You Love Me," "Far From The Home I Love" and "Anatevka."

The level off the disc is unusually high but the quality is very clean and the stereo separation excellent.

Well worth a hearing if you're interested in new shows. (W.N.W.)

* * *

HELLO DOLLY! In Dance Time. The Tommy Dorsey Orchestra under the direction of Sam Donohue. RCA "Dynagroove," Stereo. LSP-2916.

Interest: Topical dance music.
Performance: Impeccable.
Quality: Excellent.
Stereo: Variable.

"Hello Dolly!" (originally called "The Matchmaker") is the disarmingly charming saga of a semi-pro marriage broker who winds up marrying her star client. The show was a great success on Broad-

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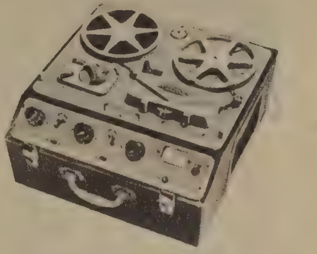

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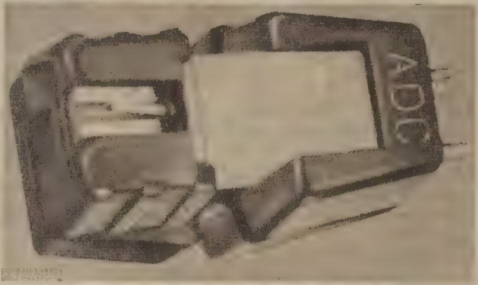

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—**Percy Wilson, M.A. "The Gramophone" (UK), Jan. '65.**

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—**Hirsch-Houck Labs. "Hi-Fi/Stereo Review" (USA) July '64.**

The July 1964 issue of "Hi-Fi Stereo Review" (U.S.A.) features an important article showing comparative performance results of all leading stereo cartridges, WHICH INCLUDE OSCILLOSCOPE PHOTOGRAPHS OF THE RESPONSE TO A 1000 CPS SQUARE WAVE AS RECORDED ON THE CBS SQUARE WAVE DISC. These comprehensive reports were conducted by Hirsch-Houck Laboratories, unexcelled in the field of audio testing, and show graphically and indisputably that ADC cartridges rate best, as their SQUARE WAVE RESPONSE IS FAR SUPERIOR TO THAT OF ANY OTHER PLAYBACK HEAD (and as their frequency response curves are extremely flat all the way out).

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way and, by all accounts, is going to be equally successful in this country.

The show features a flock of really good tunes, from ballads to rhythm numbers, which are well suited to the sound of the Tommy Dorsey Orchestra, one of the greatest bands of the great Swing Era. If you were fortunate enough to hear Tommy Dorsey in his prime, this collection will give you nostalgic chills of delight.

The numbers played are: "Hello Dolly!" "I Put My Hand In," "Elegance," "Put On Your Sunday Clothes," "Dancing," "Motherhood," "Before The Parade Passes By," "It Takes A Woman," "It Only Takes A Moment," "So Long Dearie," "Ribbons Down My Back" and "Call On Dolly."

The audio quality is right up to RCA's usual fine "Dynagroove" standard and the stereo varies between an even spread and passages of emphasised separation. (K.W.J.)

Instrumental, Vocal & Humour

MOZART — COMPLETE DANCES AND MARCHES, Volume 2. Vienna Mozart Ensemble conducted by Willi Boskovsky. Decca 12-inch stereo, SXLA 6132. Also on mono, LXTA 6132.

Interest: Minor Mozartiana.
Performance: Dry but warm.
Recording: Excellent.
Stereo Quality: Widespread.

A collection of smaller Mozart pieces, dances and marches of delightful elegance and with that indefinable and timeless freshness which seems to permeate all of the composer's works. The second volume in a complete recording of the dances and marches by Boskovsky and the Vienna Ensemble, this one features the March in D, K.408/2, the Twelve German Dances K.586, Two Minuets With Contredanses, K.463, the March in C, K.408/3, and Seven Minuets, K.65a (K.61b).

The Ensemble play with a delicate combination of dryness and warmth which to my mind suits the marches and dances admirably. I think most Mozart lovers will find the performance very much to their liking.

The recording is excellent on all points, with smooth and widespread stereo. Warmly recommended. (J.R.).

* * *

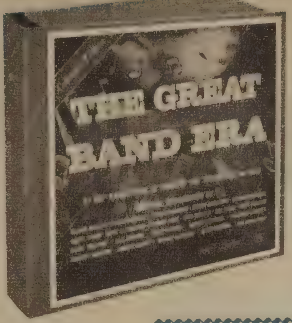
WHITE GINGER BLOSSOMS and other Hawaiian instrumental favourites composed by R. Alex Anderson. Played by The Honolulu Symphony Orchestra, conducted by George Barati. Festival Stereo SFL-931,528.

Interest: Hawaiian Symphonic.
Performance: Slick.
Quality: Good.
Stereo: Even spread.

This is a rather unusual recording in that it features the music of Hawaii played by a full symphony orchestra instead of the usual, and traditional, steel guitars, etc. This sound, although at first a little strange to the ears, later shows these numbers to have potentially wider dimensions than one is perhaps inclined to credit them with.

The various tracks are: "White Ginger Blossoms," "Lovely Hula Hands," "Island Medley," "Cherry Blossoms," "I Will Remember You," "Island Love Song,"

A NEW READER'S DIGEST ALBUM



THE GREAT BAND ERA. 10-Record Album Plus Extra Bonus Record. Stereo, "Reader's Digest." (Also available in mono.)

Interest: Pop music—1936 to 1945.
Performance: All good.
Quality: For the years involved—excellent.
Stereo: A fair imitation.

For those who remember, perhaps with a feeling of nostalgia, the big band or "swing" era of the late 30s and early 40s, "Reader's Digest" have provided, in this 10-record album, a unique collection of the most popular numbers from the top groups of the period between 1936 and 1945.

Of the 120 numbers on the discs, 80 are played by the groups (listed in order of popularity) of Tommy Dorsey, Glenn Miller, Artie Shaw, Freddy Martin, Benny Goodman, Sammy Kay, Guy Lombardo, Vaughn Monroe, Hal Kemp, Larry Clinton and Alvino Ray. The remaining 40 numbers feature 26 lesser known groups which include Duke Ellington, Charlie Spivak, Lionel Hampton, Tony Pastor, Ziggy Elman and Bunny Berigan.

Space will not permit us to list all of the numbers but, picking at random, we find such favourites as: "I'm Getting' Sentimental Over You," "Take The 'A' Train," "Moonlight Serenade," "These Foolish Things Remind Me Of You," "Sentimental Journey," "A Sailboat In The Moonlight," "Moonlight And Shadows," "It Had To Be You," "Rum And Coca Cola," "Heart And Soul," "You Must Have Been A Beautiful Baby," "That Old Black Magic," "Warsaw Concerto," "Serenade In Blue," "Blues In The Night," "Blueberry Hill," and lots of others.

In preparing this album, the Australian Reader's Digest people have closely followed a similar album released by their parent organisation on the American market, but with the important difference that some 21 numbers from the American set were omitted and their place taken by numbers from groups which had achieved greater popularity in Australia during the period concerned. In reviewing the set I had the opportunity of listening to both the American and Australian albums and must confess I am in complete agreement with the Reader's Digest decision on these numbers.

The era represented by these recordings was, perhaps, some sort of a turning point in musical history, ushering in as it did the mass adulation by teenagers (or "bobby-soxers" as they were then called) of their entertainment idols. The historical significance of the set is enhanced by the fact that these are all original recordings from the era, and not modern simulations.

The recording quality of the discs is, of course, limited by the period from which they were taken but, in my opinion, Reader's Digest and R.C.A. have done an excellent job of reprocessing the set and those with a musical interest in the period will not be disappointed on this score. The album is complete with a 24-page guide and available at the usual Reader's Digest keen price.

I derived a great deal of personal enjoyment out of reviewing this album and can heartily recommend it to anyone with an interest, historically or otherwise, in the music of 1936 to 1945. (K.W.J.).

"Mele Kalikimaka," "Malihini Mele." All of these numbers were composed by Hawaii's favourite and most prolific composer, R. Alex Anderson.

If you like the music of the islands and the idea of it being given the "Mantovani treatment" doesn't stop you, then this recording could be for you. Personally I found it very relaxing and rather a pleasant change from the usual. The audio quality is quite good, although not in the "excellent" class; the stereo is evenly spread without gimmicks of any kind. (K.W.J.).

* * *

THE BREEZE AND I. The Music of Lecuona. D'Artega And His Orchestra. Stereo, Universal Record Club SUP-539.

Interest: Orchestra, Latin-American flavour.
Performance: First class.
Quality: Absolutely clean.
Stereo: Well spread.

The jacket notes describe Ernesto Lecuona as Latin America's most famous composer and the numbers presented here as among his best known . . . numbers that "have captured all the magic of the Caribbean."

Whether or not the claims are strictly factual, I'm not sure but I won't quarrel with the summary of the music. It's tuneful, romantic, yet full of vitality and fortified freely with Latin-American rhythms.

And D'Artega, with orchestra, enters right into the spirit of it. They play: "Malaguena," "Ante El Escorial." "Jungle Drums," "Amor Que No Es Verdad," "Argnesa," "La Comparsita," "The Breeze And I," "Amor Que Bonito Has Vuelto," "No Tienes Corazon" and "El Merinaque," "Say Si Si," "Gitanerias," "Cordoba."

This is a good record at any price, better still at the Club price and a real bargain if it comes to you on a dividend basis (W.N.W.).

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THE MELODY LINGERS ON — Living Strings Plus Harp. Arranged and conducted by Johnny Douglas. Harpist Maire Goosens. R.C.A. Camden 12in stereo, CAS-847.

Interest: Favourites, old and new.
Performance: Smooth, lingering.
Recording: Very good.
Stereo Quality: Well spread.

Another of those delightfully smooth recordings of melodies so familiar and likeable that one often finds it hard to tell whether they are old or new. This collection by the Living Strings and Marie Goosens on the harp is both smooth and refreshing, and would be ideal as dinner music, "quiet evening" music, or dance music for the latter end of a party — the stage commonly referred to as "shufflin' time."

The melodies played as "The Song Is Ended (But The Melody Lingers On)," "'It Only Takes A Moment," "I've Grown Accustomed To Her Face," Medley — "Song Of India," "Estrellita," "Time On My Hands," "Shangri-La," "With The Wind and the Rain in Your Hair," "Roxanne," "Blue Moon" and "Climb Ev'ry Mountain."

The recording is very good, although the bass is a little low when played with the standard RIAA curve and "flat" controls. Distortion and noise are both very low and the stereo is spread quite smoothly. (J.R.).

* * *

LA PALOMA. Billy Vaughn And His Orchestra. Stereo, Dot (Festival) ZL-31-492. (Also Available In Mono).

Interest: Listening, dancing.
Performance: Typical Vaughn melodic.
Quality: Good.
Stereo: Normal.

As noted above, this is a typical Billy Vaughn offering, with singing sax. (or saxes) up front and the emphasis on melody. For those with an inclination to dance, he's arranged the tempos to suit although the twelve tracks with an average of about 2 minutes each, are aggravatingly short:

"La Paloma," "Time Was," "Say Si Si," "Mexicali Rose," "El Choclo," "La Golondrina," "Brazil," "Estrellita," "La Cumparsita," "Perfidia," "Yours," "The Peanut Vendor."

Still, it's pleasant listening, well recorded technically, and should find plenty of takers. (W.N.W.).

* * *

BACH ORGAN WORKS VOL. III. Gernando Germani at the Organ of St Laurens Church, Alkmaar, Holland Prelude and Fugue in E Minor ("Wedge"), BWV548; Toccata and Fugue in D Minor ("Dorian"), BWV538; Passacaglia and Fugue in C Minor, BWV582; Prelude and Fugue in D, BWV532. World Record Club 12in mono, TE-537.

Interest: Bach organ works.
Performance: Usual Germani polish.
Recording: Excellent.

The third volume in World Record's release of recordings of Fernando Germani playing on the magnificent baroque organ of Alkmaar's Grote Kirk St. Laurens, and of the same high standard as the first two (reviewed in the October and December, 1964 columns). As I mentioned before the recordings are slightly dated, but they are still regarded by many to be the definitive interpretations and performances of the works. Germani is sometimes a little stiff, occasionally stodgy, and now and again liable to the charge of over-registration, but he is probably the greatest living organ virtuoso and in general his playing is excellent.

And, of course, the further bonus with these recordings is that they are played on an instrument eminently suited to this type of music. The Alkmaar organ is almost the baroque paradigm, with plenty of the upper mutations and mixture-work so necessary to keep contrapuntal parts separate and avoid muddiness.

The playing on this disc is excellent, particularly in that delightful Prelude in BWV532. Registration is relatively reserved, and the interpretation is acute without rigidity. Some may perhaps feel it a little pedantic, but I prefer this to the looser playing often encountered. It depends how you like your Bach, obviously.

The recording itself is excellent, although only mono. There is no trace of overload, and the transparency of both bass and high treble are reproduced cleanly. Surface and tape noise are both very low.

Highly recommended to organ music lovers. (J.R.).

* * *

PIPE ORGAN FAVOURITES. Eddie Dunstedter. Mono, Capital T-2068. (Also available in stereo ST-2068.)

Interest: Theatre organ.
Performance: Smooth.
Quality: Good.

In these last few months enthusiasts of the theatre-style pipe organ have had quite a ball.

Here is your opportunity to get a record by another of the "old timers" in the person of Eddie Dunstedter playing the 4-manual 24-rank Robert Morton theatre organ, installed at the Lorin Whitney Studio, Glendale, California.

Although two or three of the numbers are mildly dramatic, Eddie Dunstedter's style is characterised more by smooth, singing melody. For added colour, he enlists the help of John Gray (strings) and Milt Holland (percussion) in four of the nine numbers.

The titles: "Sweet And Lovely," "Stardust," "I Left My Heart In San Francisco," "Whispering," "Yesterdays," Charade," "But Beautiful," "Park Avenue Fantasy" and "I Don't Know Why."

Technically, the quality of the mono version which I had for review was good with negligible background. Another pleasant disc for followers of the popular organ. (W.N.W.)

* * *

IT'S HONKY TONK TIME. Del Wood "Queen Of The Ragtime Pianists." Stereo (Electronically Reprocessed) RCA Camden CAS-796. (Also available in mono.)

Interest: Del Wood's honky tonk.
Performance: Good but not unique.
Quality: Normal
Stereo: Not specially significant.

Del Wood, whose real name is Adelaide Hazelwood, is a popular performer over American radio and television and an artist featuring regularly on Nashville's "Grand Ole Opry."

Here she turns on a perfromance of good, standard honky-tonk, garnished with a certain amount of percussion and stanzas on her electronic Solovox: "After Five," "Sentimental Journey," "Pony Boy Medley," "San Antonio," "Cheyenne," "Remember Me," "On The Sunny Side Of The Street," "Beer Barrel

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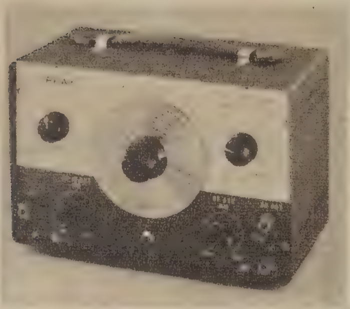

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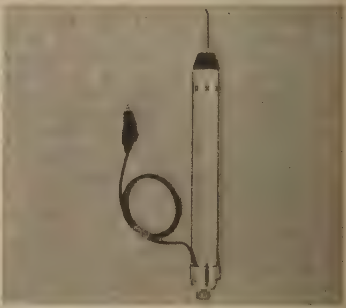

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NEW CBS TEST RECORD

SEVEN STEPS TO BETTER LISTENING. Test recording from the C.B.S. Laboratories. Stereo and Mono, STR-101.

This is a test record with a difference, explained in part, perhaps, by the fact that one finger in the pie belonged to Edward Tatnall Canby, the well-known writer in "Audio" magazine.

For the most part, test records fall into one of two groups:

The first is for the technically equipped situation and provides waveforms at a variety of frequencies and amplitudes, which can be metered in the amplifier chain and/or viewed with an oscilloscope.

The second group minimises technicalities, concentrating rather on sound effects and musical miscellania. The object is to give enhanced opportunity for appraisal of the sound system, while also providing, as often as not, material for sound demonstration.

This new C.B.S. record steers a bold middle course. It calls for no instruments other than a pair of dedicated (and educated) ears, yet its approach is purely technical, with not a bar of music, nor a word of sales promotion.

Side 1 is for stereo systems.

The listener is introduced to "white noise" (see our December, 1964, issue, page 28) and to what the announcer calls "pink noise," being what is left after the white variety is passed through relatively narrow filters.

Bands of pink noise and tone are then presented, along with spoken instructions, so that the listener can appraise and adjust his amplifier system for balance, phase, frequency response and tracking ability.

The intention is that the appraisal should be aural, so that the adjustment is on the basis of what an individual listener actually hears in his own listening situation—not what a voltmeter across the amplifier output says he should hear!

Side 2 is primarily for testing mono pickups and systems, but it is also useful with stereo systems, as verification and extension of the side 1 tests and to assess the performance of the system on mono signals.

This side begins with a test for frequency response, then a glide tone to search out room or system rattles; then follow tests for lateral and vertical tracking ability. The last may well reveal that your mono pickup has enough vertical compliance to be used safely with stereo records.

In all, it's a most interesting and useful record, which could give your system a clean bill of health or, more likely, give you cause furiously to think!

It reminded this reviewer, for example, that his ears just don't go to 16KC any more. The only hint I had of 16KC modulation was the crackle which is superimposed on the tone bursts in this section—doubtless an imperfection in the recording.

It also underscored the loss of stereo effect at progressively lower fundamental frequencies and, despite Canby's assertions in the accompanying booklet, the difficulty of verifying loudspeaker phasing by direct listening. I still prefer coded leads throughout or the alternative of wheeling the enclosures face to face and judging the phase from what comes out the crack in between!

As I said, it's a highly interesting record but, if you want one, you'll have to get in quickly. The Australian Record Company imported a batch and, I gather, when they're gone, they're gone! (W.N.W.)

Polka," "Somebody Else Is Taking My Place," "Black And White Rag," "The Little Green Valley," "When You And I Were Young Maggie Blues."

Okay at Camden's price, if you're looking for a honky-tonk. (W.N.W.)

* * *

THIS IS ETHEL ENNIS. "An Occasional Man," "Show Me A Man," "Nobody Told Me," "Auf Wiederseh'n Sweetheart," "As You Desire Me," "Wild Is Love," "The Moon Is Yellow," "Who Will Buy," "Night Club," "For Every Man There's A Woman," "Starry Eyed and Breathless," "When Did I Fall In Love." R.C.A. "Dynagroove," Stereo. LSP.-2786.

Interest Romantic vocals.
Performance: Marred.
Quality: Excellent.
Stereo: First rate.

Ethel Ennis has a sure, clear voice and a good feeling for both melody and lyric. To the melody she gives subleties of shading, a fine sense of timing and accurate intonation. The lyrics are approached with understanding and sensitivity. She sings with the clear articulation of a girl who delights in communicating.

What a pity, then, that this otherwise splendid disc should be marred by syrupy, so-so arrangements which, instead of enhancing her performance as they should be designed to do, only succeed in creating a lack-lustre effect which almost, but not quite, spoils the disc. Fortunately Miss Ennis is good enough to make the disc worth having, in spite of the backing.

The audio quality is typical "Dynagroove" standard and the stereo has a particularly natural spread. (K.W.J.).

* * *

THE ROMANTIC GUITAR OF VICENTE GOMEZ, with orchestra conducted by Charles Bud Dant. Festival, Stereo. SFL-931,485.

Interest: Spanish guitar.
Performance: Smooth.
Quality: Excellent.
Stereo: Good.

Vicente Gomez is an outstanding virtuoso guitarist who, after a most sucessful career in the concert halls and nightclubs of America, now seems to have settled into a permanent niche in Hollywood where he composes and plays much of the background music heard on motion pictures. His most recent effort

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in this direction was the score for the excellent documentary film "Goya."

In this disc Gomez plays a dozen popular Spanish melodies against an appropriate, lively orchestra background. Gomez has a style which is somewhat less impassioned than say, Escudero, and he tends to subjugate his playing to the moods of the composition. The overall effect is smooth and pleasant listening from a disc well worth hearing, particularly if you've a place in your library for some background music in Spanish style.

The audio quality of the disc is excellent and the stereo effect good, but not spectacular. (K.W.J.).

★ ★ ★

BUSH BALLADS. The Bush Music Club Sings Songs Of The Swaggies. Mono, Festival, FL-31,336.
Interest: Bush songs.
Performance: Straight from Gunn's Gully.
Quality: Normal.

According to all reports, the Bush Music Club is a dedicated group, very active in seeking out, documenting and performing traditional Australian bush songs. A round dozen of them are presented on this LP, which has reputedly enjoyed excellent sales in city and country alike.

Whether you'll enjoy it personally, or for what reason, is quite another matter and this is a question on which you'll most certainly have to make up your own mind.

The themes, the atmosphere and the voices are aggressively Orstralian even though, as pointed out in the notes, many of the numbers have a heritage in lands from which the early settlers —and convicts—came.

The titles: "Charlie Mopps," "The Ballad Of Catalpa," "To The Shores Of Botany Bay," "Dennis O'Rielly," "Paddy Fagin," "16,000 Miles From Home," "Nine Miles From Gundagai," "The Ryebuck Shearer," "The Drover's Dream," "The Ram Of Dalby," "The Flash Stockman" and "Jog Along Till Shearing."

If you do buy the disc, be prepared for some of the arguments which commonly go with folk-style music: Is it real or synthetic? Are the performers genuine in their stated convictions? Are they presenting songs or musical caricatures?

Best you make up your own mind. (W.N.W.)

★ ★ ★

LADY OF SPAIN. Mario Lanza. Mono, R.C.A. 45-EP, Gold Standard Series 20323.
Interest: Popular tenor.
Performance: Typical Lanza.
Quality: Normal.

For those with a liking for Mario Lanza, R.C.A. provides the opportunity of having on one 7in disc, four of his popular numbers. It's typically Lanza —big build-up, big voice, mannerisms and those tragic phrases where pitch goes awry.

However, on past performances, this record should sell like the rest of them: "Lady Of Spain," "Marcheta," "La Spagnola" and "Cosi Cosa. (W.N.W.).

THIS MONTH'S POPULAR JAZZ

THE BEST OF DIXIELAND featuring **the bands of Louis Armstrong, Turk Murphy, Muggsy Spanier, Bourbon Street All Star Dixielanders, Henry "Red" Allen, Bunk Johnson, The Dukes of Dixieland, Bob Scobey, Pete Kelly and His Big Seven, Jimmy McPartland, Tony Almerico, The Original Dixieland Jazz Band. R.C.A. "Electronically Reprocessed", Stereo .LSP-2982.**
Interest: Dixieland panorama.
Performance: All good.
Quality: Variable.
Stereo: Nice effect.

When I first listened to this disc I mentally formed the phrase "a real treasure trove of dixieland jazz." The phrase is by no means original, since R.C.A. use it in the jacket notes on the disc but I still feel it is the most apt description of the record's contents.

Most of the tracks were recorded in the late 50s when dixieland jazz was undergoing a revival of interest in America but some go back much earlier than that. One number ("Livery Stable Blues" by the O.D.J.B.) was recorded on February 17, 1917, and is reputed to be the first disc recording ever made. It is, in any case, certainly the first jazz recording ever made.

The numbers played are; "Rockin' Chair," "Tiger Rag," "I Wish I Could Shimmy Like My Sister Kate," "High Society," "St. James Infirmary," "The Saints," "Tin Roof Blues," "Mississippi Mud," "Oh Didn't He Ramble," "South Rampart Street Parade," "Milenberg Joys," "Livery Stable Blues."

The audio quality of the disc is, in the main, very good and the general overall sound is considerably improved by the stereo reprocessing. The one exception is the 1917 track which, as one would expect, is of rather poor quality but what it lacks in this direction it makes up in historical value. (K.W.J.).

★ ★ ★

DAYBREAK EXPRESS — DUKE ELLINGTON AND HIS ORCHESTRA. Personnel: Arthur Whetsol, Cootie Williams, Freddy Jenkins, Juan Tizol, Joe Nanton, Johnny Hodges, Barney Bigard, Harry Carney, Fred Guy, Wellman Braud, Sonny Greer, and, of course, Duke Ellington. R.C.A. "Vintage Series," Mono. LPV-506.
Interest: Ellington of the 30s.
Performance: Typical.
Quality: Thirtyish.

The 16 numbers in this album were made between June, 1931, and May, 1934, well within the Duke's "Train Period" but divided by the first voyage to Europe in 1933. This exciting time in the Duke's career, and in the development of his orchestra, has hitherto received insufficient attention on LPs, with the result that these important performances are almost unknown to most of today's jazz audience.

The numbers featured are: "Echoes Of The Jungle," "Limehouse Blues," "It's Glory," "Dinah," "Bugle Call Rag," "Rude Interlude," "Dallas Doings," "Dear Old Southland," "Daybreak Express," "Delta Serenade," "Stompy Jones," "Solitude," "Blue Feeling," "Ebony And Rhapsody," "Live And Love Tonight," "Troubled Waters."

The R.C.A. "Vintage Series" label has seen the release of some excellent jazz from earlier years and this new release is no exception to the fine standard established. The audio quality is average for the 30s, but the tracks are all chosen for artistic value rather than audio quality. (K.W.J.) ■

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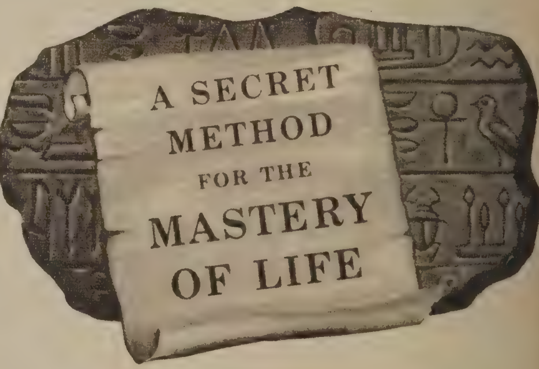

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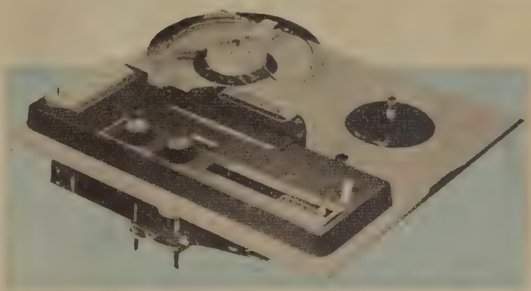
TRADE REVIEWS AND RELEASES

TRUVOX SERIES 90 TAPE DECKS

Pictured is one of the "Truvox" series 90 tape recording decks, the four-track three-head type D99. It was recently sent to our laboratory for review by the Australian distributors of Truvox equipment, Brown and Watson Electronics Pty. Ltd., of 281 Latrobe Street, Melbourne.



MANUFACTURED in England, Truvox series 90 decks employ three motors. The two spooling motors are sturdy (35W) two-pole shaded-pole induction types, while the capstan motor is an external-rotor "Papst" capacitor-run type.

Capstan drive is via a stepped motor pulley, a rubber intermediate wheel and a large cast flywheel. Three speeds are provided, 7.5ips, 3.75ips and 1.875ips; there is also an "off" position which removes the intermediate wheel from the pulley and flywheel and disconnects the mains.

Three versions of the deck are available in Australia ex-stock, a two-track two-head mono type (D92), a four-track two-head type (D94) and a four-track three-head type (D99) as sent for review. The D94 deck has slide-switch track selection and also erase head disconnection facilities for superimposition.

Deck operation on series 90 decks is controlled by five piano-key type switches, with a knob control for the speed selection. The keys control Stop, Start, Rewind, Fast Forward and Record, the last-named being part of an interlock arrangement the other part of which is a knob control marked Play/Record. The latter can only be turned to Record when the key is depressed.

The Record/Play knob control shaft does not perform any deck function, but is simply extended on the underside of the deck for the operation of circuit switches, etc. It is provided with flats to suit standard "Oak" type switch sections.

A pause control is fitted, marked "Cue," and is the usual pressure-wheel and head pad retractor. However, it is locking—a most convenient feature where a long pause is necessary — and, when released, the motion stabilises in a commendably short time. A resetable four-digit tape position indicator is fitted.

Track sense and tape motion are to international standards. Wow and flutter were not quoted, but would appear from tests to be very low indeed. The decks are of solid construction, being built around a cast base plate rather than the usual pressed metal plate(s). A handy feature is the provision of spool locking by means of expanding spindles.

The D99 deck tested was fitted with low impedance erase windings and medium/high impedance record and replay windings on the respective heads. Quoted attainable frequency response at 7.5ips is 30-20,000cps plus/minus 4dB, although our tests would suggest that to attain this treble response a fair amount of recording and replay boosting would be required.

The recommended bias/erase frequency is 62KC and, at this frequency the erase windings require 13V and the record windings 75V respectively (both RMS). Recording current is quoted as 50uA and, from our tests, it would seem that the maximum recording level possible is not much higher than this—head saturation would appear to be the limiting factor. The replay head voltage is a little lower than normal, also.

A small flap is installed to provide easy access to the heads for cleaning and demagnetising. An ingenious feature is the provision of a tape splicing jig on the underside of this flap.

Two criticisms can be made regarding the decks. The first is a relatively minor one, but it concerns deck appearance and finish, and such points often act like the metaphorical absence of a "haporth o' tar."

In this case, the annoying feature possessed by an otherwise well-finished unit is the use of stick-on printed metal foil control-panels and name-plates. These have been used on a number of other tape decks and instruments, it is true, and some of the latter products were (otherwise) quite high quality gear—but let's face it, these stick-on foil things are not good. So often they come "un-stuck," particularly where they are on a much-used control panel or a surface which gets warm in operation.

The main label of the deck tested was already almost adrift when we lifted the deck from its packing and, despite efforts to press it down again, it curled up in short order.

Surely the use of slightly thicker panels fastened to the unit with small rivets or screws would cost little more, yet it would represent a considerable gain in finish and consumer appeal!

The other criticism concerns the head winding terminations, particularly with reference to the three-head unit tested, but also of relevance to the two-head types. The winding leads are brought out to a row of lead-through insulators immediately behind the heads, and the various signal and bias/erase cables provided with the deck are connected to the lead-throughs beneath the deck. There is no shielding between the replay terminations and the rest, while the underside of the terminations is virtually inaccessible.

The lack of shielding and the fact that the user is effectively prevented from adding his own shielding due to the underneath inaccessibility mean that, with the three-head deck, the problem of bias injection into replay circuitry will be harder to solve. We experienced this difficulty at first hand when we tried out the deck with our new Playmaster 110 tape system. The suggested use of a relatively low bias/erase frequency of 62KC together with the fairly high record head impedance contribute to this problem also.

While the lack of shielding will not be of importance with two-head versions of the deck (as replay and record will not occur at the same time), the inaccessibility of the cable terminations may still be a problem for another reason — which will also apply to the three-head version. This is that the connections are for parallel bias feed to the recording head whereas, for a number of amplifier designs (such as our own Playmaster 110), series bias feed is used.

The would-be user must therefore choose between adapting to the existing cable arrangements or performing a major operation on the underside of the deck to change cables.

Notwithstanding these criticisms, the Truvox D90 series of decks and the D99 deck in particular would seem from our tests to be solidly made units, convenient in operation, and capable of excellent results when used with appropriate circuitry.

However, if the points raised in criticism were cleared up, the decks would have even greater appeal and application than at present, in the opinion of this reviewer.

Quoted retail prices for the decks are £55/13/ (D92), £59/17/ (D94) and £65/2/ (D99), which compares favourably with decks of similar quality. Inquiries may be made through the usual suppliers, or direct to the distributors at the address given above. (J.R.)

PLAYMASTER 110 TAPE COMPONENTS FROM R.C.S.

R.C.S. Radio Pty. Ltd., of 651 Forest Road, Bexley, N.S.W., announce that they are able to supply the special components pictured, intended for the currently-described Playmaster 110 tape system.

THE 65/t3 printed wiring board is available fully drilled and coated with protective and fluxative resin coating, while drilled and punched plastic front plates are available with rear-screened panel lettering. The latter take the place of the photographic print and hand drilled perspex plate described in the article, saving the constructor considerable work.

Also available and visible in the photograph is the oscillator coil, type 265. This is an equivalent to the unavailable Brenell coil, but has an extended secondary winding for use with other decks (see article in this issue). It thus becomes a virtual "universal" bias/erase coil, suitable for almost any high-quality tape application. Tested in the Playmaster 110 circuits, it was found to conform easily to specification.

NEW TRANSFORMERS FROM FERGUSON

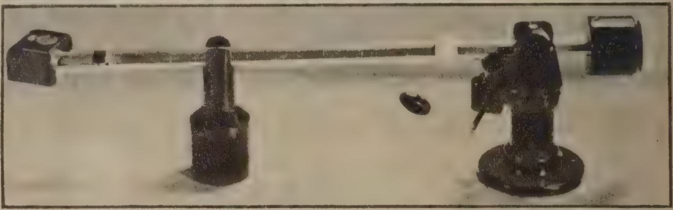
Ferguson Transformers Pty. Ltd., of 331 High Street, Chatswood, N.S.W., announce two additions to their range of small power transformers. They are the type PF2315 and the PF2228.

THE type PF2315 is a miniature filament transformer rated at 6.3 volts, 1 amp. It measures only 2½in x 1½in x 1½in overall, and features the latest in bobbin winding and varnishing techniques. It was designed expressly for applications requiring a filament transformer of small size and should be of considerable interest to experimenters and constructors of semiconductor equipment.

The PF2228 was designed originally to provide 30 volts AC to operate the B.S.R. power tuning unit, as described in the November-December articles on the "1964 23in TV Receiver." It is rated at 55VA intermittent for this and similar applications, but may find considerable use in transistor equipment as it has a conservative rating of 10VA continuous.

Trade price of the PF2315 is 22/3, and of the PF2228 is 33/4. Specification sheets are available from Ferguson Transformers on request. Supplies are already in stock (J.R.)

DECCA MARK III PERFORMS WELL



Those in the market for a good magnetic pickup should find it worth their while to take a look at the new Decca Mk III ffss head in a re-styled professional arm recently released by the Australian agents for Decca, British Merchandising Pty. Ltd.

THE re-styled professional pick-up arm is similar in principle to earlier units but of a somewhat more attractive appearance and with additional technical features. It now includes a coarse and fine counterweight adjustment for achieving dynamic balance plus a sliding counterweight and calibrated scale to cater for the complete range of ffss heads. The built-in lowering device now clamps around the pedestal and works on the bearing cover shell.

The arm bearings have been improved by the use of steel balls in nylon cups and the assembly is, as before, laterally damped with silicone fluid, though perhaps more efficiently through the use of a larger pedestal. The connecting wires are now brought out through a 4-pin socket mounted at the base of the pedestal.

The makers specifications for the new Mk. III ffss head are as follows; output—1.2mV/cm/sec. per channel; impedance—3,000 ohms at 400cps; recommended load—50K ohms; diamond stylus — minor axis 0.0003in, major axis 0.0008in; tip mass—less than 1 milligram; tip compliance—lateral 15 x 10 to the minus 6cm/dyme and vertical 4 x 10 to the minus 6cm/dyme; frequency response — plus or minus 1DB from 40cps to 16KC; cross talk — better than minus 20DB at 1KC and minus 15DB at 50cps and 12KC; balance (between channels) — better than 1DB; recommended playing weight — 2 grams.

The major difference between this pickup and the earlier Mk II model is in the use of a stylus with a square shank and an ellipsoidal tip, as against the use of a circular shank and spherical tip. There is also an increase in compliance and a reduction of tip mass, which is reflected in a lower playing weight.

When checked on a variety of test records in our laboratory, the pickup performed very well and seemed to easily meet all specifications. The ability of the unit to handle heavy passages without distortion was particularly noticeable and, in fact, it easily produced perfect sinewave output on a 400cps tone cut at 8DB above standard recording level and on an inner track of the record.

This whole combination of arm and pickup is, we feel, a really excellent one, although it does have two minor shortcomings.

The pickup head, in common with many units of this type, has quite a substantial magnetic field surrounding it and is attracted to any ferrous materials in the turntable or motor baseplate. This means, in effect, that completely non-ferrous motor/turntable combinations must be used if correct and even tracking weight is to be achieved. Care must also be taken to isolate the pickup from stray hum fields.

The second shortcoming concerns the very short distance by which the stylus projects from the head. This minimal projection is an inherent feature of the design but it does mean that the pickup and pickup arm must be mounted absolutely parallel to the record surface if front and rear end fouling are to be avoided. In this position the stylus will enter the groove vertically and, although this is an optimum position for Decca and some other pressings it is not optimum for many, and particularly American, pressings.

Be that as it may, the pickup sounded very good indeed on current R.C.A. dynagroove pressings, stylus angle notwithstanding.

The price of the pickup head only, is £23/7/ and the arm is £30/10/9. The combination arm and head in an attractive presentation package is £53/17/9 retail. Further inquiries should be directed to British Merchandising Pty. Ltd. of 60 Clarence Street, Sydney.

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AKAI PORTABLE STEREO RECORDER

A major feature of the new AKAI model X-IV stereo tape recorder, recently released in Australia by Magnecord Australasia Pty. Ltd., is the "cross-field" head arrangement. This unique recording technique was developed by AKAI and results in a remarkably good frequency response being achieved, particularly at low tape speeds.

Above, the model X-1V Akai recorder and, below, the supplementary mains supply and power amplifier unit, as described.

THE new model X-IV recorder is housed in an attractive, functional and yet most robust all-metal case with "piano keyboard" type deck controls and machine-finished aluminium knobs on concentric controls for volume, tone and tape speed.

Separate level meters and microphone input sockets are provided for each channel and a "mic/line" switch is included to give proper level compensation when recording from pickups, radios and sources other than the microphones provided with the recorder.

Brief specifications of the recorder are as follow: power requirements — DC (6 volts, 2.6 ampere hour rechargeable battery) and AC(100 to 245 volts from AC adaptor) both units included as standard equipment; heads — standard ¼-track record/play and erase with cross-field bias heads, shielded and plastic impregnated; recording level indicator — two "VU" type meters, one of which doubles as a battery voltage indicator; tape speed — 7½, 3¾, 1-7/8 and 15/16in per second; motor — deviationless DC micro-motor; wow and flutter—less than 0.16 per cent rms at 7½ips and less than 0.35 per cent rms at 15/16ips; frequency response — 40 to 20,000cps at 7½ips, 40 to 17,000cps at 3¾ips, 30 to 11,000cps at 1-7/8ips and 30 to 5,500cps at 15/16ips (all figures plus or minus 3DB); power output — 2 watts maximum on each channel; signal-to-noise ratio — 40DB (compared to recorded signal level); channel separation—better than 60DB at 1KC; input level—100 microvolts for microphone and 60 millivolts for line input.

As supplied, the recorder is nicely packed in a wooden framework in which it is spring-suspended to guard against damage in transit. The accessories are individually packed in a foam plastic section of the box. These accessories include: A combined AC power supply, battery charger and right channel power amplifier (the left channel power amplifier is included in the recorder); two separate high-quality, dynamic microphones complete with desk stands and a single neck band; a 5in reel of prerecorded demonstration tape and a spare 5in reel; splicing tape; a 6-volt rechargeable battery, two connecting cables, a vinyl case for the recorder; operator's manual.

Other optional accessories available for the recorder include: remote control unit type XRC-1; stereo earphones type XSR-2 for stereo monitoring or playback from the unit in portable form; telephone pickup type XTP-3 for direct inductive pickup from any standard telephone; 7in reel adaptor type XTA-4; de luxe carrying case made from solid leather and having separate storage section for the microphones and with all controls accessible without removing the recorder from the case.

The recorder is fully transistorised with a total of 19 transistors including those used in the regulated AC mains supply and in speed control of the DC micromotor. This speed control of the unit is, incidently, extremely good, with such things as wow and flutter being reduced to a bare minimum. It is claimed, further, that the deviation in motor speed will not be greater than 0.8 per cent even after 1,000 hours of continuous running.

In our laboratory tests of the unit, we found it would easily meet its frequency response and other specifications and, in fact, frequencies up to 30KC could be recorded at 7½in per second at tolerable losses. We understand that this particular model recorder was chosen for use in the Antarctic because of its ability to faithfully record frequencies of 20KC under arduous portable conditions.

The demonstration tape provided with the machine features several musical excerpts recorded at 1-7/8ips and the playback of this tape into our "bookshelf" enclosures provided a really convincing demonstration of the machine's capabilities at low tape speeds.

All things considered, this would appear to be a really fine little machine for the enthusiast who demands portability as well as near professional performance from a recorder.

The price of the machine, complete with all accessories mentioned, is £196/15/ (retail), Any further inquiries should be directed to Magnecord Australasia Pty. Ltd., of 158 Clarence Street, Sydney, N.S.W.

In Brief

National Instrument Company Pty. Ltd. advise the release of a new Heterodyne Voltmeter by their principals, Messrs Bruel and Kjaer. The voltmeter, type 2006, is a completely new design. It is fully transistorised, battery operated and easily portable whereby the instrument fulfills the need for a selective voltmeter for field use.

The frequency range is 40KC-230MC which is especially useful for measurements of antennae, amplifiers and distribution systems for AM, FM and TV receivers, transistorised RF circuits, receivers and transmitters. A built-in meter allows the direct reading of carrier levels in modulated waves as well as the amount of modulation. AM and FM. Inquiries may be addressed to the above company at 1-5 Sydney Street, Marrickville, N.S.W.

Amalgamated Wireless Valve Co. Pty. Ltd. announce a range of new special-purpose valves for professional applications. The first of these is the Photomultiplier XP 1100. This valve is a four-stage photomultiplier designed for application in photometry and measuring and control systems. The XP 1100 is well suited for operation in the red and infrared ranges.

Production has also commenced of four types of photoconductors, types RPY 10, RPY 11, RPY 12 and RPY 25, which are intended for manifold applications. The light-sensitive material of these photoconductors consists of cadmium sulphide.

Final news is the release of three indicating valves types ZM 1020, ZM 1021 and ZM 1080. Types ZM1020 and ZM1080 are numerical indicating valves and ZM1021 is a symbol indicating valve. Comprehensive information on all these items is available on request from the customer's advisory department of Amalgamated Wireless Valve Co. Pty. Ltd., Sydney, Melbourne, Brisbane and Adelaide.

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RECORDING TAPE FROM KODAK

Kodak (Australasia) Pty. Ltd. announce the release of a new range of high quality ¼in and ½in wide sound recording tape and a new magnetic sound recording film. The tapes are manufactured in America by the Eastman Kodak Company who have been marketing magnetic tape in that country for a number of years.

THERE are, in all, some 15 different type numbers of tape available in the range from Kodak, made up of combinations of three types of magnetic dispersion, formulated for low print-through and high output, and coated on to the two types of bases, each of several thicknesses.

The two types of bases used on the Kodak tapes are "Durol Base," which is a support made of specially modified cellulose tri-acetate, and "Polyester Base," which is stronger than acetate bases, thus lending itself to the extreme thinness required for extended play tapes.

Kodak claim that their new "Durol Base" tape is 40 per cent stronger than conventional acetate bases and that it will break clean in the event of a sudden stress without seriously stretching first. The broken ends of the tape can thus be spliced together with little, if any, loss or spoilage of recorded material.

On the Durol Base, Kodak make a standard play and a high output tape of 1½ mil thickness and an extra play tape of 1 mil thickness. On their "Polyester Base" the company produce extra play, double play and triple play tapes of 1½, 1 and ½ mil thicknesses. All of these tapes are available in the standard reel sizes of 3, 5, and 7 inches and in various professional reel sizes up to 7.200 feet.

Kodak claim their new tapes to all have low print-through, low noise performance and full audio frequency range response. The tapes have built-in lubrication for smooth transport and they are said to resist scratching, tearing and stretching.

The tapes are supplied on a unique Kodak "Thread Easy" reel which is almost self-threading. This reel is also numbered on both sides for easy identification and has a unique recessed splicing jig on both flanges. Also included on the reel is a footage indicator and an opaque section on which identifying information may be recorded with an ordinary lead pencil.

The tape, as supplied, is fully enclosed in a dust-proof polyethylene bag and packaged in a convenient one-piece box with full instructions on the inside. There is space for data on the outside of the box.

Kodak sound recording tapes are available from retail stores or Kodak branches located in the major cities throughout Australia. Any further inquiries should be directed to Kodak (Australasia) Pty. Ltd., of 173 Elizabeth St., Coburg, Victoria. ■

AMATEUR BAND NEWS AND NOTES

Fine W.I.C.E.N. Job in Bushfires

During the recent disastrous bushfires in Gippsland the W.I.C.E.N. organisation of the Victorian Division of the Wireless Institute of Australia played an important part in providing communication links in the stricken areas. This report tells of their service to the community..

By Pierce Healy, VK2APQ *

OVER 80 Victorian amateurs were part of the vast army that fought the recent disastrous fires at Gippsland in Victoria. Over 60 of these amateurs were in the fire area, the remainder manning base stations.

A total of 40 private cars equipped with 146MC FM or 80 metre equipment were used at one time or another. The Amateur's role in these fires lasted for eight days.

By Wednesday, March 3, 1965, fires had been burning in heavily timbered country in the Gippsland hills for nearly a fortnight. Until that time the fires had posed no serious threat to persons or property. However on that day the joint State Co-ordinators of the Victorian W.I.C.E.N. Organisation, John Battrick VK3OR and Michael Owen VK3ZEO, were advised by the Liaison Officer of the State Disaster Plan that the fires in the Gippsland hills were causing grave concern and that the State Disaster Plan could be involved, requiring W.I.C.E.N. assistance.

Simultaneously the local P.M.G. Divisional engineer (who is directly responsible for communications in the area) was contacting the Eastern Zone W.I.C.E.N. Co-ordinator, Graham Collie VK3QZ. Thereafter the Zone and State Co-ordinators were in close contact with each other and with the P.M.G. Officers in the area and in Melbourne. At the same time metropolitan and country W.I.C.E.N. operators were alerted. Even at that early stage it was clear that the immense communication problem posed by fire that could stretch for over 60 miles could only be met by a heavy commitment of amateurs from the metropolitan and other zones not directly involved.

On the following day, Thursday, March 4, further discussion took place, the Zone and State Co-ordinators being kept constantly informed of developments in the situation. On Thursday afternoon it was decided that a nucleus of a net should be established by establishing base stations at the two places selected to be base headquarters, Heyfield and Bairnsdale. As well, the Institute's official station VK3WI and the Zone Co-ordinator's home station were also to be manned.

Therefore in the early evening of that Thursday the first group of four amateurs from the metropolitan area was on its way to the area 180 miles away, to assist zone members establishing these base stations. With this first group was the W.I.C.E.N. State Controller, Harold Hepburn VK3AFQ. He was one of those to remain in the area for the whole of the emergency, and for most of the period was to bear much of the responsibility for the operation in the area.

The plan was to establish these base stations with a minimum commitment of personnel and equipment, to form the nucleus of a net if a heavier commitment was needed. These stations were in operation by early Friday.

By Friday lunch time the situation had deteriorated so much that W.I.C.E.N. Organisation was requested to provide mobile units to be attached to the two base headquarters.

That afternoon the first group of mobiles left the metropolitan area and were the first of a large number of mobile units to ultimately be utilised.

Those that assisted came from all over Victoria. Lack of sleep was an occupational hazard. Food and drink varied from the lavish to the breadline. Showers and even decent washes were dreams rather than realities, and danger was always near.

In the eight days that the emergency lasted and W.I.C.E.N. was employed, a total of four disaster headquarters were manned. The first two were in Heyfield and Bairnsdale and the tasks undertaken consisted in the main of accompanying water tankers and fire carts to the fire fronts and providing them with a speedy and reliable means of passing situation reports and requests for further assistance back to the main plotting table at headquarters.

This, in turn, facilitated a quick appreciation of the total fire situation in the whole area and was part of the vital communications function in enabling the co-ordination of all the available resources to provide assistance where it was most needed.

On one occasion two W.I.C.E.N. operators travelling in a car were trapped on a bridge over a creek, with fires burning on either side of the creek. The operators jumped into the creek but even there found that their hair was singed, though of course it was quickly doused. The bridge was sprayed by the fire tanker and the operators were able to resume their tasks.

Another incident that many operators recalled was when the W.I.C.E.N. station established at Ensay sent a message to the disaster headquarters at Lucknow that the birth of a baby was imminent. The roads to Ensay were cut, medical assistance was needed and an immediate blood transfusion was a possibility. The Bairnsdale Medical Clinic was contacted and further information was obtained through the amateur networks. A St. John Ambulance was ultimately successful in negotiating the roads to Ensay and the mother was brought back to Bairnsdale.

By the evening of Sunday, March 7, the fires in the Bairnsdale and Heyfield areas had been confined. The town of Bairnsdale was safe. Accordingly the Heyfield disaster headquarters and its associated W.I.C.E.N. operators were transferred to Bruthen. This small township is about 15 miles north of Bairnsdale and was at the time still surrounded by fire. At various times fire had cut the Bairnsdale-Bruthen road, the Omeo-Bruthen road, and the Buchan-Bruthen road and at one time, on Saturday morning, had entered Bruthen township itself, destroying some eight houses.

Since this town was strategically placed at the junction of both the road system in the area and the P.M.G. trunk line system, it became of great importance. From Monday March 8, until it rained on the following Friday the fight to save Bruthen became a continual battle and the fires were never far from the town.

On several occasions W.I.C.E.N. operators found themselves isolated as the winds fanned smouldering fires into blazes and

Latest Report on Oscar III Contacts

Oscar III — orbiting satellite carrying amateur radio — was launched into space on March 10. At the time these notes were being compiled, it had completed 244 orbits of the earth, each taking 103 minutes.

From overseas reports, it appears that in the prime function as a translator satellite, it has operated according to plan, but in Australia the result has been somewhat disappointing.

However, the absence of signals from the 145.95MC transmitter has led to the belief that the antenna system was damaged when the satellite was ejected from the rocket.

News of some of the early observations and contacts made via Oscar III came from Roy Hart, VK2HO, co-ordinator for the Oscar project in Australia, as follows:—

First reception of amateur signal relayed via Oscar III, K6GSJ heard K6UGH on orbit 1.

First reported long distance reception of a relayed signal: W4WNH heard by W8PT on orbit 6.

First reported two-way contact was made by K9AAJ and K2IEJ on orbit 13.

First reported international contact was between HB9RG (Switzerland) and DL6EZA (Germany) on orbit 20.

First reported trans-Atlantic reception, W1BU heard HB9RG on orbit 19.

First reported trans-Pacific reception, KH6UK heard WA6MGZ on orbit 51.

First reported trans-America reception, K6HMS heard LU3DCA (Argentina) on orbit 14.

First reported Alaska-U.S.A. reception, K9AAJ heard KL7CUH on orbit 9.

First reported trans-Continental contact, W6NLZ and K2GUG on orbit 35.

First reported trans-Atlantic contact, W1BU worked DL3YBA (Germany) on orbit 61.

First reported trans-Pacific contact, WA6MGZ worked KH6AQP on orbit 64.

First reported Alaska-U.S.A. contact, WA6MGZ worked KL7CUH on orbit 65.

First reported trans-America contact, W6QJW worked LU3DCA (Argentina) on orbit 69.

The only reported contact in Australia was between VK7BK and VK7LZ.

There was considerable activity in the eastern States during the early stages of the experiment. But the general opinion expressed was that much higher power than that allowed Australian amateurs was necessary to activate the translator, possibly due to damage to the satellite antenna.

Latest report from the Oscar Project Organisation is that Oscar IV possibly will be launched in September.

***News and notes of Divisional and Club activities, submitted for inclusion in these columns, should be forwarded direct to Pierce Healy, 69 Taylor St., Bankstown, N.S.W.**

first this and then that road was temporarily blocked by falling trees.

The confluence of trunk telephone lines at Bruthen and the successful quelling of the fires around Bairnsdale led to a new role for W.I.C.E.N. It became its task to provide an alternative means of communication while the P.M.G. lines were being restored after being cut by fire or falling trees and during this period many urgent personal messages were carried to the homes of many people.

With Bruthen as the base station, additional stations were set up at Ensay and Tambo Crossing (about 40 miles to the north of Bruthen), at Orbost (some 40 miles to the east) and at Gelantipy away to the north-east of Bruthen. These four stations were roughly in the form of a square and a 24-hour watch on 3550KC was kept to ensure no loss of vital communications when telephone lines were cut.

This role was a dramatic change from the surprisingly adventuresome job of providing communications to the fire front and most operators found the transition to a frankly irksome job of watch-keeping a difficult one.

Fire fighting and fire spotting was transferred to Gelantipy where a small force of four mobile units operated for about three days in the wild bush country near the Snowy River. The fires had started in this area and it is hoped finished there.

It was in this area that the provision of communication for fire fighting parties was doubly necessary and the ability to spot, report and douse stray fires started by airborne fragments of still burning debris was an essential task.

Throughout the emergency two main base stations were utilised. VK3WI at the divisional premises in East Melbourne was manned 24 hours a day, as was the home station of the Zone Co-ordinator, Graham Collie VK3QZ at Traralgon.

These stations sent and received messages to and from the various disaster headquarters in the field. VK3WI was connected by direct telephone lines to the disaster room at the Russell Street Police Headquarters. In addition to the passing of messages, VK3WI and VK3QZ were responsible for keeping the high frequency channel policed and anyone using the channel for non-emergency purposes was requested to change frequency to ensure that no interference to traffic was experienced by stations in the fire areas.

Since there were four medium powered stations operating from the Bairnsdale Headquarters (W.I.C.E.N., Country Fire Authority, Army, and Country Roads Board) mutual interference became intolerable. therefore a 6 metre AM link was set up between the disaster headquarters and the home of a local amateur VK3LL in Bairnsdale and all Melbourne bound traffic was routed through this link to V3LL for re-transmission to Melbourne. Due to high noise level at VK3WI, 80 metre traffic was received by VK3ZCE at Frankston and relayed via a separate FM channel into the city.

In addition to the communication function performed by W.I.C.E.N. throughout the emergency, many of the operators were given the job of repairing the C.F.A. transmitters and receivers. One P.M.G. officer has commented that it is now realised that due to the vastness of the area covered and the many fronts of operation, the emergency could not have been controlled without the big and complex communication system of which W.I.C.E.N. performed a vital part.

A P.M.G. representative at one of the headquarters was told by Country Fire Authority officers and Forest Commission officers that in all its tasks W.I.C.E.N. operators had fulfilled a vital function.

The part played by the communication services in this emergency was perhaps best summed up in the following statement by Mr H. S. Robertson, the Co-ordinator of Communications under the State Disaster Plan.

Mr Robertson said: "The communications network, provided to assist the fire fighting and auxiliary services, was the largest ever established during a major disaster in Victoria. This network was set up quickly in accordance with a pre-arranged plan and operated at a very high level of efficiency throughout the disaster period. In this plan, W.I.C.E.N. was assigned an important role and in its achievement earned well merited and enthusiastic praise for all participating authorities. W.I.C.E.N. members can feel justifiably proud of a job well done."

W.I.C.E.N. IN VICTORIA

The starting point of the WIRELESS INSTITUTE CIVIL EMERGENCY NETWORK Organisation in Victoria, as it exists today, was undoubtedly the disastrous fires in the Dandenong Ranges in January 1962. There a small number of Victorian Amateurs were pressed into service and were able to use VHF FM mobile equipment obtained through the Victorian Division's disposals committee.

Up to that time W.I.C.E.N. was little more than a name. It formed no part of any larger overall organisation, had no official recognition, and generated little enthusiasm.

As a result of those fires, the State Disaster Plan was developed in the years that followed and W.I.C.E.N. became part of that plan. The broad concept of the State Distster Plan was to co-ordinate all services that would be involved in a major disaster and, in particular, to enable the service which was directly responsible for dealing with the emergency to deal with it effectively with as much assistance as is possible.

The Victorian Police became responsible for the ultimate co-ordination of all services and the Chief Commissioner of Police became the chairman of the State's Diasaster Committee of Police became the chairman of the State's Disaster Committee. Other members of the committee were responsible for equipment, medical assistance, communications, and welfare.

Communications became the responsibility of Mr H. S. Robertson of the Postmaster General's Department. As well as the resources of that Department, W.I.C.E.N. became responsible for providing radio communications. It was decided at an early stage that its activities should be built around net operation on two frequencies, 3550KC and 145.854MC FM.

Very strenuous efforts were made by the Victorian Division to obtain as much suitable equipment as possible in order to foster mobile net operation on a day-to-day basis, to enrol sufficient operators, and to conduct suitable exercises for W.I.C.E.N. operators, both alone and in conjunction with other organisations involved in the State Disaster Plan.

It was basic to the thinking of the Victorian W.I.C.E.N. Organisation that interest should be maintained over a long period. To this end repititious practice nets were avoided completely. Heavy reliance was placed on large scale and intrinsically interesting exercises once or twice a year. At all times the closest possible liaison was maintained with the P.M.G. Officers responsible for co-ordinating the communications of the Plan.

The first exercise was constructed around a two-day car trial in September 1963. W.I.C.E.N. activities were watched by the P.M.G. Co-ordinators of the State Disaster Plan and this exercise enabled a good assessment of both the strengths and weaknesses of the W.I.C.E.N. system then operative. It also emphasised to the authorities the potential of the Amateur body for emergency communications.

They appreciated the significance of a competent body of operators, all volunteers, who could both operate and maintain their own equipment, whose hobby was communications, and who were, within themselves, both highly organised and self-disciplined.

Over the succeeding year several more exercises were held in conjunction with the

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State Disaster Plan built around simulated emergencies and each time W.I.C.E.N. was found to be better equipped, better manned, and in every sense more capable of coping with demands that were made of it.

One of the most important decisions made during this period was to form a striking force of six mobiles whose operators were able to obtain their employers' permission to be available at any time for emergency work. It was (and still is) the job of this small task force to be the first to the scene of any disaster where W.I.C.E.N. assistance is required and to start operation as soon as possible. If the particular incident called for additional operators and equipment then all available means could be used to summon, brief, and deploy these additional personnel.

This second phase was co-ordinated by VK3W1 on the net frequencies and by telephone.

This was the planning behind the large scale utilisation of W.I.C.E.N. in Victoria during March 1965, and it was within this framework so many gave so much of their time and effort to assist in these potentially disastrous fires. That no lives were lost is in itself a tribute to the success of the State Disaster Plan, and the Victorian W.I.C.E.N. operators can be proud that they form a vital and effective part of this organisation.

Acknowledgement is made to the Victorian W.I.C.E.N. Co-ordinators for making this report available prior to it being published in the W.I.A. magazine "Amateur Radio."

WIRELESS INSTITUTE ACTIVITIES

The Annual General meeting of the N.S.W. Division was held at W.I. Centre, Crow's Nest, on Friday evening, March 27.

In presenting the Annual Report the Retiring President Vic Cole VK2VL drew attention to the following points:—

Membership totals 1218, there was a good average attendance at the monthly meetings, and interesting lectures had been presented at each of these meetings.

Divisional Broadcasts had been given each Sunday morning from the Divisional Transmitting station VK2WI Dural. Very little trouble occurred with the equipment.

The Bulletin had been circulated to members each month and in addition a VHF Newsletter was started and has a growing circulation list.

Disposals trading was down compared to previous years but the Disposal Committee continued to procure equipment for members.

In the Education field the Slow Morse Practice sessions and the CW Tape Service, together with the Taped Lecture Service proved to be as popular as ever. The Youth Radio Scheme made excellent progress and finished the year with 32 registered Clubs.

Despite the Sunspot Minima and poor conditions, the QSL Bureau handled a greater number of cards than for any of the last five years.

The report also referred to the work done by individual members and Committees and on behalf of Council and members generally, expressed appreciation to those concerned.

There were only six nominations and no ballot was necessary. Those nominating were automatically elected, as follows: Ivan Agar VK2AIM; Chas Wilkins VK2ALB; John Van De Lear VK2IQ; Bill Lewis VK2YB; Jack Young VK2OY and Ray Biddle VK2DB.

During the meeting, a number of members spoke on various aspects of Division activities and all present expressed their appreciation of the work done by the retiring President and Council.

VHF CONVENTION

The first VHF Convention organised by the VHF and TV Group of the N.S.W. Division was held over the first weekend in March.

It commenced with the usual monthly meeting, on Friday evening, March 5. About 50 members attended and heard several lecturettes, including some on portable generators for field days. Practical demonstrations of several units were given.

From the discussion the consensus of opinion was, that with the units running at constant speed and continuously loaded as is the case in field day operation, there is little need for voltage regulators on the units. It was pointed out by several speakers that more often than not a voltage regulator limited the output of the generator rather than providing protection against overload.

On Saturday morning over 70 members and friends visited Kingsford Smith Airport to inspect the French designed radar installation. The officer on duty gave practical demonstrations and answered numerous technical questions. The tour was continued through the communications equipment room where the teletype and aircraft to ground high frequency radio communication was being maintained.

In the afternoon a twilight "fox hunt" was held. The transmitter was hidden by David MacNaughton VK2ZVW and the event was won by Brian Anderson VK2AND with Phil Irvine VK2ZPI in second place. A get-together for tea took place at Lake Parramatta, but the total fire ban (due to the extremely hot weather) prevented the planned barbecue.

The evening event was a "hidden transmitter hunt" which was won by Mac VK2ZH with Peter VK2ZZW. Paul VK2ZPJ hid the transmitter.

The main mobile activity, on Sunday 7, was a field day at the Willows Picnic Ground on the banks of Cattai Creek. A "scramble" on the way to the picnic ground was won by Dave Andrews VK2AWZ, with Dick Norman VK2ZCF second, and Bob Lear VK2ASZ in third place.

The next event was a "mobile fox hunt" with the following result: Bob Lear VK2ASZ; Dick Norman VK2ZCF and Harold Bortoft VK2AAH tying for second, and Phil Irvine VK2ZPI and Dave Andrews VK2AWZ tying for third place.

After lunch the most hectic event of the day was held; a "pedestrian fox hunt," when 15 starters lined up determined to take out the honours for the event. However, only seven finished the course which, according to army survey maps, was only over a distance of 0.6 mile air line—but apparently much further by foot. Results: 1st, Allan Williams VK2ZAL; 2nd, Joe Mack VK2ZJM; 3rd, Stephan Kuhl VK2ZSK. Others to finish the course included VK2ZAU; VK2AWZ; VK2ZCF; VK2ZIW.

The final event was quite amusing to those who hid the transmitter and were watching from a concealed position nearby. Practically all the contestants arrived within the vicinity of the transmitter where utter confusion seemed to reign, for despite the signal strength and the use of "sniffers" no one could determine where the signal was coming from. Finally, while all others were exploring the surrounding bush, Joe Pollock VK2ZOO observed a piece of coaxial cable to which was attached the antenna—buried in the middle of the track. Second place was won by Bob Lear VK2ASZ with Phil Irvine VK2ZPI third.

Proceedings concluded with prizes being presented to the winners of all contests.

The success of the convention has already started plans for a bigger and better event next year.

HUNTER BRANCH

The annual meeting of the Hunter branch was held at the Newcastle Technical College on Friday evening, March 5. Fifty-two members were present. The president, Frank Cox, VK2APO, extended a warm welcome to the divisional president, Vic Cole, VK2VL, and Federal Councillor

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MR3P 'VU' Meter	47/6
MR3P 300 volt A.C.	50/-

MO65 3¼in Round Face, 2½in Hole, 1½in Deep. Black Plastic Case.

MO65 100uA.DC	55/
MO65 500uA.DC	37/6
MO65 1Ma.DC	35/
MO65 5Ma.DC	35/
MO65 10Ma.DC	35/
MO65 20Ma.DC	35/
MO65 50Ma.DC	35/
MO65 100Ma.DC	35/
MO65 150Ma.DC	35/
MO65 250Ma.DC	35/
MO65 500Ma.DC	35/
MO65 15v DC	35/
MO65 30v DC	35/
MO65 300v DC	42/6
MO65 300v AC	42/6
MO65 1Amp.DC	35/
MO65 30-0-30 Amp. DC	42/6
M065 50 mV D.C.	37/6
M065 100 mV D.C.	37/6

MR52 2½in Square Face, 2in Round Hole, Black Plastic Case.

MR52 500uA.DC	47/6
MR52 1Ma.DC	£2
MR52 5Ma.DC	£2
MR52 10Ma.DC	£2
MR52 25Ma.DC	£2
MR52 50Ma.DC	£2
MR52 100Ma.DC	£2
MR52 250Ma.DC	£2
MR52 500Ma.DC	£2

LOG BOOKS, 5/6 each, postage 1/-.

CLIENTS PLEASE NOTE

ALL PRICES QUOTED IN THIS ADVERTISEMENT INCLUDE SALES TAX WHERE APPLICABLE. PLEASE ADD POSTAGE WHEN ORDERING. SORRY, NO C.O.D.

Pierce Healy, VK2APQ, who had journeyed from Sydney to attend.

In his report on branch activities during the past year, Frank, VK2APO, stated that the monthly meetings had been well attended, and some interesting lectures presented, adding to the technical knowledge of members as well as providing a social get-together.

The weekly broadcasts had been maintained at a high standard while the "Do It Yourself" and constructional competitions also showed a high standard.

Comment was also made on the standard of operating and expressed the thought that some improvement could be made. Recommended that Hunter branch members make an effort during the next 12 months to set an example to all operators in the use of the correct procedures, and correct use of the phonetic alphabet.

SILENT KEY

On March 15, Wal Hannam, VK2AXH, passed away at his home at Terrigal, N.S.W. Wal was well known to Australian and New Zealand amateurs with whom he maintained contact on 80 metres.

His association with amateur radio dated back to 1908 when he was first licensed, and in 1910 in association with other amateurs of the day who organised themselves into what was then called The Wireless Institute of New South Wales, becoming its first secretary.

In 1911 he joined the Douglas (later Sir Douglas) Mawson expedition to the Antarctic as a radio operator, the transmitter being a two-kilowatt Telefunken. Messages were transmitted to Macquarie Island where they were relayed to Hobart.

On returning from the Antarctic, Wal enlisted in the first A.I.F. and served overseas with the Divisional Engineers, again in radio.

An active operator, he had many friends locally and in New Zealand with whom he maintained regular contacts.

The funeral took place at the Northern Suburbs Crematorium on Wednesday, March 17, and was attended by many members of the New South Wales Division of the W.I.A., including representatives of council, Hunter branch and Central Coast sections.

By a strange coincidence, the funeral took place three years to the day after Wal unveiled a plaque at the opening of the Divisional headquarters — Wireless Institute Centre—at Crow's Nest.

The sympathy of all amateurs is extended to the relatives of this fine old amateur.

The report concluded with thanks being expressed to the secretary, treasurer and mmittee for their assistance and work ring the year.

All offices being declared vacant, Vic ole was invited to preside over the election officers for the ensuing year.

Nominations were called for and the llowing elected:—

President: Frank Cox, VK2APO.
Vice-Presidents: Les Baber, VK2RJ, Keith oward, VK2AKX.
Secretary: Gordon Sutherland, VK2ZSG.
Treasurer: Bill Hall, VK2XT.
Social Secretary: Bill Munn, VK2ZWM.
Zone Correspondent: Keith Howard, K2AKX; Assistant, Frank Cox, VK2APO.
VHF Liaison Officer: Tony Mullen, K2ZCT.
QSL Officer: Stan Lloyd, VK2AYL.

After congratulating the new committee their appointment, Vic Cole gave a sume of Divisional activities and answered any questions on matters of interest to anch members.

The evening concluded with the business the normal monthly meeting during ich, Pierce, VK2APQ, discussed Institute atters from a Federal point of view.

The May meeting of the Hunter branch will be held at 8 p.m. on Friday 7th in Room 6, Clegg Building, Newcastle Technical College, Tighes Hill. Visitors and intending members will be welcome.

BLUE MOUNTAINS SECTION

The annual meeting of the Blue Mountains Section of The N.S.W. Division was held on April 19, and there was a good attendance.

The retiring chairman, Bob Lear, VK2ASZ, reported on the section's activities during the past year. Dave Melbourne, VK2NK, Civil Defence signals officer, discussed future Civil Defence activities in the area, in which radio amateurs would be co-operating.

Election of officers for the ensuing year resulted in the following appointments, all being unopposed.

Chairman: Don Hodgson, VK2ART.
Vice-Chairman: Dereck Boyd, VK2NR.
Secretary: Bill Moore, VK2HZ.
Treasurer: Allan Smith, Assoc.
Publicity Officer: Bob Lear, VK2ASZ.

Among the retiring officers was Norm Durham, VK2QA, treasurer since the inception of the section in 1958, who due to a change in employment would not be able to attend meetings regularly.

The section meets at their club rooms in the Old Council Chambers, Lawson, on the third Friday of each month. Visitors will be very welcome.

VICTORIAN DIVISION

The annual general meeting of the Victorian Division VHF Group was held on Wednesday evening, March 17. The officers elected for the ensuing year were:—

Chairman: Cyril Edmonds, VK3AEE.
Vice-Chairman: Jack Taylor, VK3ZJF.
Secretary: Len Pointer, VK3ZGP.

W.I.A. YOUTH RADIO SCHEME

The first Radio Instructor's Certificate (Grade 2) has been awarded to Keith Howard, VK2AKX. This award was made in recognition of the excellent work done in instructing Youth Radio Scheme members. The efficiency of this work has been judged by the number of students who have passed various Y.R.S. tests or have obtained the A.O.C.P. or L.A.O.C.P. To date, Keith has a fine tally of five A.O.C.P., two L-A.O.C.P., four Junior Radio Certificates, and 17 Elementary Radio Certificates.

Second to gain the Instructor's Certificate is Ken Mattai, VK1KM, who also has a fine tally of five A.O.C.P., 14 Elementary, and 13 Junior Radio Certificates.

The supervisor of the Y.R.S., in announcing the requirements for the Instructor's Certificate, stated that it is not proposed that these awards shall be lightly earned, but will be recognition for consistent instructional effort over a considerable period.

NEW SOUTH WALES

The "Efficiency Pennant" presented by the Institution of Radio and Electronic Engineers has been won by the Westlakes Radio Club.

A monthly newsletter edited by Jim Webster can be obtained by sending a stamped self-addressed envelope to him, C/- Science Department, Birrong Boys' High School, Birrong, N.S.W.

The March issue contained six pages of news from various clubs as well as a number of articles of particular interest to anyone seeking information regarding the scheme.

WESTERN AUSTRALIA

Laurie Jessop, VK6ZEA, co-ordinator of the Y.R.S. in that State and club leader at Wesley College in south Perth, has reported that four club members were awarded Commonwealth Scholarships. They are: Peter Pemberton, VK6ZEP, Ray Godley, VK6ZEG, Terry Broom and Mervin Wellnagel. Both the latter have passed the L.A.O.C.P. and are awaiting their call signs.

The club is very active from their newly built club room and operate regularly under their call VK6ZEW.

QUEENSLAND

Reports from Chas. Taylor, VK4UC, indicate that a record year of Y.R.S. activity seems assured for that State. Inquiries have been received from Maryborough State School, Rockhampton Christian Brothers, Gladstone State School, The Boy Scout group at Cairns, and St. Patrick's College, Mackay, for information and assistance in starting clubs.

A De La Salle club member and one from the Grammar School club have passed the L.A.O.C.P. examination, the latter being 15½ years of age.

VICTORIA

A meeting of Y.R.S. instructors has been arranged to enable an exchange of ideas and discussion on various aspects of the scheme.

In conjunction with their other activities, The Bentleigh Youth Club has started a radio club and has associated with the Y.R.S. organisation.

The Christian Brothers Club at Bundoora have been issued with the call sign VK3ZFR for their club station. Members are now busy building a two-metre transmitter.

Steady progress is being made at the Victorian Blind Institute. The team of instructors now includes Bruce Whitehead, Ron Everett, Bob Whalley, George Weir and blind operator Cyril Minns, VK3AUM.

The Victorian organisers express their thanks to the Aegis Manufacturing Co., Thornbury, for the donation of a large quantity of knobs suitable for volume controls.

WESTLAKES RADIO CLUB

Following the results of the January examination, three members have been notified that they have qualified for the L.A.O.C.P. All three are now practising the code in an endeavour to obtain the full licence.

The new transmitting room for the VK2AWX transmitter has been completed. The soundproofing has eliminated the background noise due to the proximity to the railway line.

The first Westlakes-Hunter branch field day will be held at the Westlakes Radio Club, Teralba, on the Queen's Birthday holiday weekend in June. As an encouragement to younger members, the majority of the transmitter hunts will be on foot, both 40-metre and 2-metre being hidden during the day. Short wave portables are ideal for transmitter hunting on 40 metres. Refreshments will be available and the entry fee will be 5/ for the day.

The next unit in the series "Electronics by Radio" will be given on four Monday nights in June. The unit is to be entitled '"Electrons in Motion."

Full lecture notes will be available after June 1 and further details of the course will be given in the June issue of these notes.

TRANSISTOR SERVICE
ALL JAPANESE MAKES
REPAIRED
including . . .
Aristone
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Fujiya
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We do not sell spare parts
PETER G. BROUGHTON
209 George Street,
Sydney. Tel. 27-5831

SPECIAL PURCHASE OF FACTORY STOCK

RESISTORS, CONDENSERS AND POTENTIOMETERS

We have purchased the resistor and condenser stock of manufacturers including S.T.C. and Stromberg-Carlson who have ceased the manufacture of television and radio receivers and can offer same at less than 25 per cent of list price.

The resistors are mainly I.R.C. and Morganite in values from 200 ohm. to 5 meg in ½, 1 and 2 watt ratings and include some wire wound resistors. List price, £4/10/- per 100. **Our Price, 20/- per 100.** Post and packing, 2/6 extra.

The condensers are in most popular makes and include mica, ceramic, paper and electrolytic in standard values. List price, £5/10/- per 100. **Our Price, 20/- per 100.** Post and packing, 3/6 extra.

The potentiometers are all current types and include switch pots. and dual concentric. List price, £6 per dozen. **Our Price, 25/- per dozen.** Post and packing, 2/6 extra.

FREE For a limited period with each lot of resistors, condensers or potentiometers purchased we will supply free: One New Valve Type 6U7G or 1T4 or One New English Miniature 11 x 1 Switch as advertised on this page.

New English Miniature 11 x 1 Switches

These new miniature eleven-position single-bank switches are 1" diam. with ¼" spindle, they have silver-plated contacts and high quality insulation suitable for H.F. use.

4/9 each. Post and packing 1/6.

NEW GARRARD RECORD CHANGERS

These New English Garrard Changers with High Fidelity Crystal Pick-ups and Sapphire Styli have just been superseded. We are selling same at LESS THAN HALF PRICE. Available in STEREO at £12/15/. POST AND PACKING EXTRA: N.S.W., 15/-; QLD., VIC., TAS., 22/6; W.A., S.A., 30/-.

HIGH-SPEED 240V. AC/DC MOTORS

These 240 v. a.c. or d.c. motors are 1/8 H.P. with a speed of 7,000 R.P.M. and are ideal for small drills, grinders, etc. Dimensions, 5½in x 3½in, with 5/16in spindle 37/6

Post, N.S.W. 5/-; Post, Interstate, 8/6.

NEW 4-SPEED STEREO PLAYER F.O.R. £8/15/0

NEW STEREO CHANGER, 4-SPEED F.O.R. £10/15/0

SLIDER-SWITCHES

10 pole 2-way silver plated contacts 3/9

TYGAN AND SARLON SPEAKER GRILLE FABRIC

54in wide. List price 60/- per yard. To clear at 40/- per yard.

Postage and packing N.S.W., 3/6; Interstate, 4/6.

LEADER SIGNAL GENERATOR LSG11

240V A.C. operated. 6 band 120KC to 390 Megs. Provision for crystal. **£15/-/-**

Post N.S.W. 7/6; Interstate 12/6.

BATTERY CHARGER RECTIFIERS

New Selenium Rectifiers, 6 or 12 volt, at 4 amp., 37/6. Post, N.S.W., 2/; Interstate, 2/. Transformer for above rectifier tapped for 6 or 12 volt, with circuit for charger, 47/6. Post, N.S.W., 7/6; Interstate, 10/. As above, 6 or 12 v., at 2 amp, 27/6. Post: N.S.W., 3/6; Interstate, 4/6. Transformer for above, 37/6. Post: N.S.W., 3/6; Interstate, 4/6.

NEW 240V. A.C. MOTORS

These small motors, size 3in x 3in x 3½in, are 1-12 h.p. but are only suitable for intermittent use. 29/6. Post N.S.W. 3/6. Int. 5/

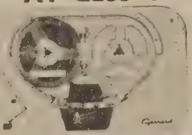
NEW A.W.A. OAK SYNCHRONOUS VIBRATORS, 7-pin, 6v. 7/6. Post and Packing 2/.

NEW B.S.R. TAPE DECKS

These new 3-speed B.S.R. Decks are fitted with a digital counter and will take 7" spools.

2 Track £17/15/. 4 Track £22/12/6.

NEW GARRARD TAPE DECKS
AT LESS THAN HALF PRICE



SINGLE SPEED 3¾in takes 4in spools. Two motors, simplified controls, supplied with tape **£9/19/6:** Post and packing N.S.W. 12/6. Interstate 20/.

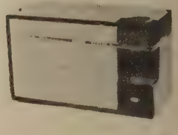
OSC. COILS 15/-

NEW 4" EXTENSION SPEAKERS

These 4" speakers are mounted in polished cabinets suitable for use as intercom. units or extension speakers.

LIST PRICE .. .. £6.

SPECIAL PURCHASE ENABLES US TO SELL THESE UNITS AT 40/. Post and packing, N.S.W., 6/9. Interstate, 9/9.



NEW ELECTROLYTIC CONDENSERS AT LESS THAN HALF PRICE

70 mfd + 30 mfd 400v	9 6	70 mfd + 25 + 5 + 5 400v W	12 6
100 mfd + 200 mfd 350v.	12 6	8 mfd 400v pig tail	4 6
50 mfd 12v	2 0	16 mfd 400v	5 6
64 mfd 350v	7 6	25 mfd 25v	2 9
16 mfd + 8 mfd 300v W	7 6		

POST EXTRA

NEW AMERICAN TWIN TELESCOPE TV AERIALS

Extends to 36in each section can be used singly for car or portable radio. 20/

POST 2/-.

NEW 17 & 25 WATT P.A. AMPLIFIERS

25 WATT	£26/17/6
17 WATT	£21/17/6

Post Extra on 15 Watt N.S.W. 10/ Interstate 15/. 25 Watt by Rail or Air. Too Heavy for Post.

The 25 Watt Amplifier uses 5 valves plus 2 rectifiers including two EF86 low noise valves as microphone preamplifier and two EL34 valves in push-pull output.

All amplifiers are fitted with A. and R. output transformers with voice coil tappings of 2 to 15 ohms. **The 25 watt amplifier can be supplied with line output transformer tapped from 100 to 600 ohms if required at 20/- extra.**

Inputs provided for microphone, pick-up, and radio with mixing facilities and tone control.

The 15 watt is as above but using two 6BQ5 valves in push-pull output.

12in speaker for above (10 watt) 67/6

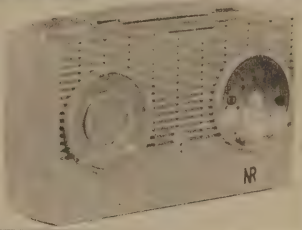
Crystal Microphones for amplifier 47/6

NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE 56-7398.

Special Purchase of Manufacturer's stock of Transistors and Transistor Components enables us to offer Transistors and Kit-sets at a fraction of original cost.

Complete KIT for TRANSISTOR 6 PORTABLE £10/19/6



The complete kit of parts for the transistor six includes six transistors, printed circuit board, coil kit, 4in speaker, Ferguson driver and output transformers, heavy duty battery and all necessary parts to complete the set with full instructions. **Set is housed in attractive plastic case as illustrated.**

Set can be supplied wired and tested at £2 extra.

Dials available for all States. Post and Packing extra N.S.W., 10/; Interstate, 13/.

NEW ENGLISH MAZDA TRANSISTORS

TYPE	EQUIVALENT		
XA101	OC45	R.F. Transistor	5/6 ea.
XA102	OC44	Osc. Transistor	7/6 ea.
XB103	OC75	Audio general purpose	7/6 ea.
MTC71	OC71	General Purpose	7/6 ea.

Ducon type SFT 123 equiv. OC74 .. .. 7/6 ea.
Available in matched pairs at .. .. 15/ pair
AUDIO OUTPUT
Post and packing on transistors 1/6 any quantity.

A.W.A. 23" E.H.T. transformers and 23" 110 deg. deflection yokes. New manufacturers stock E.H.T. units 50/-. Deflection yokes 50/-. Post free

NEW VALVES AT BARGAIN PRICES

866	15/
6X5GT	7/6
5Y3GT	9/9
5Z4G	12/6
6J6	12/
1T4	4/6
3S4	10/
1A7GT	9/6
1D8GT	9/6
6K8G	6/9
6SJ7GT	9/6
12K8	10/
EK32	6/9
6SA7GT	9/6
6SH7	5/6
1Q5G	2/6
1P5G	2/6
1C7G	3/
1K5G	4/
1M5G	4/
1K7G	4/
6C8G	8/
6SS7	8/6
6H6GT	2/6
6K7GT	7/9
6U7G	5/
7C7	3/6
12AU7	11/6
12AT7	10/
6SN7	9/6
6F6	10/
12SK7	8/
6B8	10/6
VR65A	2/6
7193	2/
12A6	8/
12SH7	5/
6K7G	4/6
955	2/6
954	2/6

Please add postage on all valves.

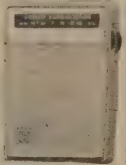
NEW 4-SPEED STEREO & MONO PLAYERS
AT LESS THAN HALF PRICE

PHILIPS 4-SPEED 6V BATTERY PLAYER

MONO	£4/17/6
STEREO	£5/17/6

Post and Packing, N.S.W. 7/6.
Post & Packing Interstate 12/6 extra

NEW IMPORTED "NATIONAL" TRANSISTOR SIX PORTABLES

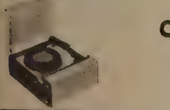


These small Portables, size 3½in x 2¼in x 1¼in have excellent tone and good sensitivity. Selling at less than wholesale price.

£14/17/6 (Post free)

Supplied with leather case.

NEW PORTABLE RECORD PLAYER CASES TO SUIT THE ABOVE TURNTABLE



Attractive two-tone cabinet with plastic trim.
Supplied with 5in x 7in speaker in felt-lined enclosure.
Space for amplifier and batteries or power supply.
Dimensions 15in x 13in x 7in.

£5/15/- Post and Packing: N.S.W. 9/-. Interstate 12/-.

MITY-AMP

5-Transistor amplifier, 2 watt output, 6 or 12 volt input, 3 to 35 ohm output. Suitable for record players, inter-com. or any application where a small amplifier is required. Circuit supplied. **£7/15/-**

Post and Packing 5/.

EXTENSION SPEAKERS

ew 9 x 6 speakers in case with volume ontrol, 75/. Post: Interstate, 5/6; N.S.W., 4/.

EW POWER TRANSFORMERS

0mA prim.: 240v with 230v tapping Sec. 35 x 285 with 6.3v filament winding 0mA., 25/-. Plus postage: N.S.W., 3/6; nterstate, 5/3.

rim.: 240v, Sec. 385 x 385 at 80 mA, fil. 3 and 5v., 27/6. Post.: N.S.W., 4/; Inrstate, 7/6.

mA H.T. Chokes, 7/6. Post: 2/-.

SHOP SOILED 80 M.A. TRANSFORMER

285 x 285

wo 6.3 volt windings 15/- each plus post. N.S.W. 6/-, Interstate 10/-.

M.G. PRESS TO TALK HAND SETS, 25/- each.

Post and pack 3/-.

NEW AMERICAN RECORDING TAPE
At ½ List Price

5¾in 900ft Acetape	£1/2/6
7in spool 1800ft Mylar,	£2/2/6
5¾in spool 1650ft Mylar	£1/17/6
5in 800ft Mylar	£1/5/0
10½in spool 3650ft Mylar	£4/15/0

Post and packing, 2/6 extra.

NEW MIDGET POWER TRANS.

40mA prim., 250v. Sec. 225 x 225 with 6.3v Fil. Winding.

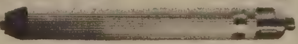
27/6 **Postage: N.S.W., 2/6; Interstate, 4/6.**

30mA 240v Prim. 150 x 150v. Sec. with 6.3v Fil. Winding.

27/6 **Postage: N.S.W., 2/6; Interstate, 3/6.**

TRANSISTORISED SIGNAL INJECTOR, 55/-

A MUST FOR QUICK TROUBLE SHOOTING
Using TWO Transistors, complete with instruction sheet and battery. Post free



NEW PER-MAG SPEAKERS by Australia's leading Manufacturer

6in Per Mag	35/
3½in Per Mag	22/6
5in Per Mag	27/6
5in x 7in Per Mag	32/6
Post and Pack. 3/6, N.S.W.; Inter.	4/6
6in x 9in Per Mag	37/6
3¼in Per Mag Tweeter with Cross Over Condenser	20/
6in x 9in Per Mag Hvy. dty. 15 ohm	42/6
8in per Mag	37/6
12in Per Mag	67/6
12in Per Mag 20 watt	135/

Post and Pack. 5/- N.S.W., 7/6 Interstate

12in Per Mag .... 67/6, Post and Packing 7/6 N.S.W., 10/- Interstate.
Speaker Transformers for above 6T, 5T or 7T 10/-

NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD STANMORE, N.S.W. PHONE 56-7398.

CRYSTAL PYE DIVISION

Manufacturers of Quartz Crystals for frequency control and Crystal Filters for highly selective circuits in the largest and most modern crystal plant in the southern hemisphere announce a new range of:—

CLOSE TOLERANCE GOLD PLATED CRYSTALS FOR AMATEUR APPLICATIONS

1.8 Mc/s to 15 Mc/s ±0.005% in Style "D" (American HC6/U holders. ¼in pin spacing. **Amateur net £2/16/3 incl. tax.**

15 Mc/s to 52 Mc/s ±0.005% in Style "D" (American HC6/U) holders. ¼in pin spacing. **Amateur net £3/2/- incl. tax.**

100 kc/s ±0.005% in HC13/U holders. ¼in pin spacing.
1 Mc/s ±0.005% in Style "D" (American HC6/U) holders. ¼in pin spacing. Specially designed for Xtal Calibrator purposes. **Amateur net £4/10/- incl. tax.**

455 kc/s (nominal) crystals for Filter applications in Style "D" or "E" (B7-G) holders. **Amateur net £4/10/- incl. tax.**

Many other types and tolerances are available from our standard production. Please consult us on your Xtal requirements.

PYE PROPRIETARY LIMITED
CRYSTAL DIVISION
CLARINDA ROAD, CLAYTON, VIC.
P. O. BOX 105. TELEPHONE: 544-0361.

THE ADEL NIBBLING TOOL

CUTS • NOTCHES • TRIMS

SHEET STEEL to 18 gauge

ALUMINIUM, COPPER, BRASS, PUNCHING BAKELITE to 16 gauge

A precision tool for custom-built radio assemblies, special sheet metal work in factory or home.

NOTE LOW COST 75/- ONLY

FROM:
RADIO SUPPLY STORES EVERYWHERE
or direct from distributors. Tax exempt. Post free within Australia.
WATKIN WYNNE PTY. LTD., 21 FALCON STREET, CROWS NEST, N.S.W. 43-2107, 43-1912

Treasurer: Peter Cohn, VK3ZPC.
Publicity Officer: Cyril Maude, VK3ZCK.
QSL Manager: Bill Rice, VK3ABP.

The Constitution of the Group was read to the meeting and adopted. A talk on the Oscar III satellite was given by Bill Rice, VK3ABP, which included a tape recording of the signal. Cyril Edmonds, VK3AEE, gave a description and full circuit details of his 432MC transistorised converter.

QUEENSLAND

Plans are being made for the "Sunshine State Contest" to be held in July. A proposal for the rules of this year's contest has been circulated to all members and is based on a scoring system of Zones according to the W.I.C.E.N. Map.

The Division has installed a Galaxy 5 SSB transceiver for use on Divisional broadcasts from VK4WI each Sunday morning at 8 am.

It is proposed, by the combined efforts of amateurs from the Darling Downs and Brisbane, to establish a 144MC beacon on the Bunya Mountains at an elevation of approximately 3,500 feet above sea level.

This installation will be of value for checking band openings and VHF propagation phenomena.

SOUTH AUSTRALIA

The South Australian, South-Eastern Radio Group will hold their annual convention at Mount Gambier on the Queen's Birthday holiday weekend.

The registration fee will be approximately £1. Full details will be published later.

VK/ZL/OCEANIA DX CONTEST 1964

Jock Whyte, ZL2GX, contest and awards manager of the New Zealand Association of Radio Transmitters, sends full results of the 1964 VK/ZL/Oceania DX Contest held last October.

Scores for the Australian (VK) and New Zealand (ZL) CW and Phone sections are as follows:—

Aust. (VK) CW		Phone	
VK2EO	9650 pts.	VK2APK	6495 pts.
VK2GW	9405 pts.	VK2WD	4465 pts.
VK2APK	8315 pts.	VK2AKF	2405 pts.
VK2RA	7315 pts.	VK2MR	1580 pts.
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A very attractive certificate will be sen to the winners of each section of th contest.

LISTENING AROUND THE WORLD

Art Cushen's monthly report on long-distance short-wave, television and broadcast band reception.

Radio Canada's 20 Years Service

Radio Canada has recenty celebrated 20 years of operation. During this time it has increased broadcasting hours to 100 per week and broadened transmissions to include 11 languages.

THE service first commenced in February 1945, when two 50KW transmitters were stalled at Sackville on the New Brunswick oast of the Atlantic Ocean some 600 iles from the Montreal studios. The first ansmissions were beamed to Europe in ur languages to counter German propanda.

The station later added Danish, Noregian, Swedish, German, Polish, Russian, alian, French and English to Europe, panish and Portuguese to Latin America d English to Australasia and the South cific.

During the 20 years the station has ceived over half a million letters from teners with comments which have helped give the listener the type of entertainent and information they desire. More cently transmissions to Africa have been mmenced. These include programs in glish and French, which are being well ceived in that part of the world. The cent addition of a third 50KW transitter has enabled three frequencies to be operation, giving listeners a choice of nds on which to hear Radio Canada.

The service ranked fifth in the shortve station popularity poll last year, while Radio Canada Short-Wave Club is a pular feature with listeners. This is heard the Australasian service on Sunday at 35 and 0825 GMT, on 5970 and 9625-. On Monday Listeners Corner, a session which letters and questions from listeners answered, is carried in the transssion beamed to the South Pacific. The nsmission is 0715-0800 and repeated 00-0845, on the two frequencies 5970 d 9625KC.

NEW PAPUA-NEW GUINEA STATIONS.

Two new stations have commenced to erate under the Australian Administran of Papua and New Guinea. One is ated at Daru in Papua and the other at roka in New Guinea.

The Radio Daru station, assigned the call 8BD, is using the frequency of 3304KC d a power of 250 watts. The signal is ll received from 0900 onwards, mostly pular music is played, with announcents of the time and station slogan adio Daru" following each recording; sign is at 1000 hours GMT.

Radio Goroka, using the call sign VL9CG operating on 2410KC also with 250W. e signals here are weaker, probably bese of the lower frequency. The program ears to be all in pidgin but frequency ntification and time announcements are be heard.

AFRICAN SIGNALS.

The reception from stations in Africa tinues to be a topic of major interest short-wave listeners. With the low sunt conditions, some new and unusual sigs are to be heard when listening at wn in this part of the world. One of our ders, Bob Padula in Mount Albert, Victia supplies an interesting list of stations has been hearing, which will aid readers find some of the more elusive signals.

3215KC, Lourenco Marques, Mozambique; fair to weak with English 1945GMT.

3270, Lusaka, Zambia; good with English at 2000.

3288, Tananarive, Malgasy Republic; French and native music 1930.

4800, Radio Somali; good at 1945 in local programing.

4835, Lourenco Marques, Mozamibque; Enlish program at 1755.

4850, Mauritius, Forest Side, good, relays BBC news 1800, French at 1810 and then popular music; sign off 1830 with National anthem.

5020, Miamey, Niger; heard with program in French at 2000.

9720, Radio Senegal, Dakar; news in French at 2215, and can be heard at times with sign-off at 2400 hours GMT.

11835, Radio Algiers, Algeria; sign-on at 0700 in French.

11900, Radio Nigeria, Lagos; opens at 1900 in French program over the signals of Radio South Africa.

NEW SCHEDULE FROM BUDAPEST

A new schedule for the English transmissions from Radio Budapest, in Hungary is now in operation in the services to North America. These transmissions should give good daytime reception in our winter. The transmissions are in English and the new schedule is:

0030-0100	6234, 7305, 9540, 9833KC.
0130-0200	6235, 7305, 9833.
0300-0330	6235, 7215, 7305, 9833.

CANARY ISLANDS ON 1180KC

Reception of the new Radio Nacional station in the Canary Islands was reported in a previous issue, when we received its signals on 9660KC. Reception is also now possible on the frequency of 11800KC, from midnight to 0300 hours GMT. Steve Thurlow reports that the signals in Cabramatta, N.S.W. are best for the period 0200 to 0300, when news is heard at 0200; music follows to station sign-off.

This new regional station of Radio Nacional de Espania, is on the air from 0800-2300 on 620KC on BC band. It is on short-wave from 1400-1600 on 9660KC, and 0000-0300 on 11800KC.

TESTS FROM SEOUL

Test transmissions from Seoul have recently been conducted by the Korean Broadcasting System, beamed to South Vietnam, for reception by the Korean Forces serving in the Saigon area. Four transmissions are being carried at present, with announcements in French, Vietnamese and English. The English announcement by a male speaker is first, then French and Vietnamese follow with a woman announcer. The station requests reports from any part of the world.

The test at 0000-0030 GMT is the best received, when the frequency of 15125KC is used. The program consists of frequency announcements, interspersed with musical numbers. Three other transmissions are 1330-1400 on 9640; 2300-2330 on 11925 and 1530-1600 on 11926KC. Reports should be sent to The Voice of Free Korea, Seoul, South Korea.

LISBON ON 7130KC

Reception of the transmission for listeners in Europe has been noted on a new frequency from Lisbon, when the station uses 7130KC to sign-off at 0830GMT, with the slogan "Emisora Nacional." In this service for listeners in Europe, the station has a news bulletin in Portuguese at 0800 and a musical program to 0830. The station in its closing announcement gives location and frequencies in use and then follows the clock chime for the half-hour. The transmission concludes with the National anthem of Portugal. At this time of the day, reception from stations in Europe are being heard in the 41-metre band at good level, and this new frequency for Lisbon is one free from interference.

LEBANON USES 9750KC

A new frequency replacing the old 9625-KC, has been put into use by the Lebanon Broadcasting System in Beirut. The transmission beamed to North America is now 9750KC and gives good reception during the English period 0230-0300. The station has news at 0250GMT: it closes at 0300 with an English announcement which gives the frequency as 9750KC and states that, from 0300 to 0330, the program is in Arabic and in Spanish from 0330-0400. The Lebanon Broadcasting System, since installing this new 100KW transmitter, has been heard well on several frequencies and verifies reports by a card from its studios in Beirut, Lebanon.

BERLIN TO AFRICA

Details of the transmissions of Radio Berlin International in its services to Africa have come from one of our readers, Michael Hardy, of Liverpool N.S.W. The transmissions, eight of which are beamed to Africa, are as follows: 0415-0435 on

A recent brodcast in the B.B.C. Short Wave Listeners' Corner was from the Daventry transmitter site. Frank Hennig is shown interviewing W. H. Thornycroft, engineer in charge, and E. A. Beaumont, superintendent engineer, B.B.C. External Broadcasting (extreme left). Listeners' Corner is heard on Friday at 0030 and 0935-GMT.

SOUND PROJECTORS

Cinevox Prefect or Victor Pyrox 16mm in good working order. 240v operated, complete with speaker and amplifier.

£47/10/-

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3¼in diameter. Will do the same work as the conventional slide rule. Instruction book included.

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Contains these lenses:
1 Lens 1in Focus. 1½in diam.
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1 Lampholder.

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Car phone 70-85 mcs. 12 volt, with leads connector and control unit. £22/10/.

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F.24 Mark IV 2.9. Lens. stops 11, 8, 5.6, 4, 2.9.
With 3" x 8" F1. Lenses complete with wooden case.

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Tape printers model 47.R 240 Volts operated.

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Number 22 (Aust.) can easily be converted to Number 122 set, which is ideal for ship to ship and ship to shore radio service. Complete with power supply. Leads, Phones and Mikes,, etc., less crystal.

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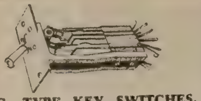

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1.2 Volt fully charged, 4in x 3in x 1in 4 AH.

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80	12/6	6F8	7/6
41	12/6	6N7	10/
5U4G	9/6	6R7	5/
77	10/	6L7	5/
VR150-30	10/	7L7	5/
5CP1	39/6	5678	2/6
EF50	3/6	12SK7	5/
6U7	7/6	VR1120	5/
VI103	10/	VR118	7/6
VH120	7/6	VR65	2/6
1L4	10/	6R7GT	5/
717A	7/6	VT4C	7/6
K4C	10/	AU5	10/
10	10/	VU120	10/
5Y3	12/6	VR116	10/
6C4	5/	957	5/
6AG5	5/		

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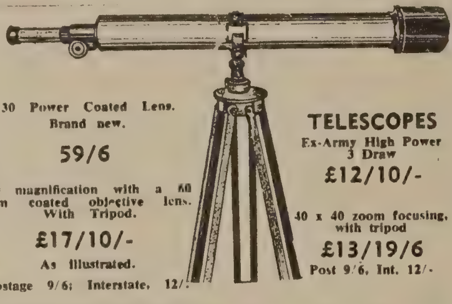

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As illustrated.

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40 x 40 zoom focusing, with tripod

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Post 9/6, Int. 12/-

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I.R.C. brand new ½w, 1w, 2w, tolerances between 1 and not exceeding 5% including 100, 360, 560, 750, 15K, 22K, 27K, 100K, 180K, 220K, 560K, 820K, ohms. Usual price 4/- each, 50 assorted different values for only

37/6. Post 1/6

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3¼in, Reflector, 126 magnification. Complete with 4x finder and equatorial mount.

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11795KC; 0630-0730 9560; 1245-1330 17825; 1400-1430 11795; 1400-1430 11820; 1515-1545 11820; 1800-1830 9560KC. A session heard at 1200 on 15240 and 11750 is beamed to Asia and Africa.

BBC WORLD SERVICE

As from May 1 the BBC's General Overseas Service became the BBC World Service, a name more fitting for the broadcasts in English from London, which are on the air for 23 hours a day. The present General Overseas Service followed the war-ime Forces and Empire program, and has grown until now it serves the whole world at various times of the day when listening s most suitable in the reception area. The new World Service is silent only for the eriod 0800-0900 GMT: for the rest of he 24 hours it has its transmissions beamed n various areas. In the Pacific, the World ervice from London serves us from 600-0800, 0900-1115 and from 2000 to 215 GMT, but the program can also be vell received from transmitters beamed to ther areas at times when the Pacific is ot being given direct service.

VOICE OF FREE CHINA

A new schedule and frequency plan has een announced by the Voice of Free hina in Taipeh, Taiwan, which means a ter release of the service for listeners in ustralia and New Zealand. The station ow broadcasts in English as follows:

250-0350 North America and Japan
7130, 9685, 11860KC.
930-1045 Korea and Japan
6095, 7130, 9685, 11825.
045-1115 Japan (in Japanese)
6095, 7130, 11825, 11860.
130-1330 Australia, New Zealand, S.E. sia
7130, 9685, 11860, 17890.
430-1610 South Asia.
7130, 9685, 9755, 11825, 11860.
545-1715 Africa in French
9755, 11825, 11860.

B.B.C. SOUTH ATLANTIC RELAY

Work has now commenced on the South tlantic relay station for the B.B.C. according to information in the B.B.C. Handbook r 1965; the station is expected to be in rvice by 1966. The station will have ur 250KW transmitters which will im-ove the B.B.C. coverage throughout est, Central and South Africa, South merica and the Central American area. e transmitting site is on Ascencion land in the South Atlantic.

Another B.B.C. relay station, this one on broadcast band frequency of 701KC, back in operation, located in the Somali epublic in East Africa. The transmitter s been silent for some months due to a litical difference between Britain and the mali Republic. The station relays the C Arabic service to East Africa, the iddle East and Central Africa, and can heard on 701KC at 1800GMT. Big n is heard, when the station is relaying normal BBC Arabic service.

FLASHES FROM EVERYWHERE

NDWARD ISLAND broadcasting station at St. George, Grenada, has been eard during the recent cricket tests be-ween Australia and the West Indies at xcellent strength. The best reception has een on 11895KC at 2000 hours GMT, ut a new frequency, 9780KC, has been operation from 2230 to 2345 hours ith the transmission beamed to Britain. ower on both transmissions is 5000 atts.

BANIA, with the transmission from Tir-na, has been heard at the new time of 630GMT with a 30-minute program in nglish. Best reception is on 7090KC. he English schedule has been extended nd is broadcast from 0630-0700 on 7090 nd 9390KC; 2000-2030, 2130-2200 on 090 and 9390. German is broadcast om 1800 to 1930 on 7090, 2030-2100-130-2200 on 7850. According to a Swiss broadcast a new service in Greek has been noted from 1545 to 1600 on 7090KC.

B.B.C. WEST AFRICAN RELAY SERVICE

THE new West Africa relay station of the British Broadcasting Corporation took over its relay facilities on March 15 and will carry the B.B.C. African language programs, and also take relays of the World Service from London. The station is at present using only one frequency, 9555KC in the 31M band and it is on the air from 0500 to 2245 G.M.T. The transmissions of the World Service is 0500-0515, 0600-0630, 0700-0730 and 1600-1700, 1715-1830, 2000-2010, 2115-2245. During the rest of the transmission for the day the station carries the B.B.C. programs in Somali, Husa, Arabic, and other West African languages. The new station is listed to provide coverage of The Ivory Coast, Upper Volta, Niger, Nigeria, Dahomey, Togoland and Ghana.

INDONESIA, in the service from Djakarta, is on the air in Arabic from 1615 to 1700 hours, French 1700-1800, Indonesian 1800-1900 and English 1900 to 2000 on 9868 and 11710KC. The last channel, 11710 is blocked by Voice of America for the entire transmission. The session in English at 1900 is beamed to Europe and is also listed for reception in New Zealand on the reverse side of the beam.

MOZAMBIQUE, the home of the Radio Club of Mozambique and the powerful commercial station in Lurenco Marques, is now on the air in English and Afrikaans, 0400-0430 on 4835, 11780; 0430-1700 on 4835, 11760; 1700-1730 4835, 11780; 1730-2200 on 3215, 4835KC, and 2200-2400 on 3215KC only.

THE PHILIPPINES station of the Far East Broadcasting Company in Manila has a transmission to Australia on DZF3 using 15385KC. The service is on the air at 2230GMT, while an additional channel, 17810KC DZ16, also carries the program. The station has a news bulletin at 2330/0255 and 0400GMT. The Pacific Hour from Manila on 11855KC is on the air 0900-1000 at good level.

BAGDAD in Iraq, which has been heard on 15300KC, is now on 15395KC and opens at 1000GMT as formerly. The station uses the sound of a bird whistle as its identification signal before the opening identification and at 1100GMT clock chimes are heard striking the hour of 2. Sign-off is at 1130GMT.

TOKYO's General Service transmission in English now has three frequencies in the 31M band, in the session 1700-1730. Frequencies are 9505, 9605 and 9740KC, all giving good reception.

TEHERAN continues to be heard on new frequencies in its service with new high-

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PYE REPORTER RADIO TELEPHONES, EX-CABS.
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BATTERY CHARGING RECTIFIER
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CARTON OF OVER £5 WORTH OF PARTS, ONLY £2-0-0.

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Bulgin Push Button
2/6 each

A.W.A. CHOKES
20 milli Henries, 16 amps D.C.
£3/10/ each.

CIRCUIT BOARDS CARD TYPE
These Boards are plug-in circuits from 6 channel target tracker type (1). Contains 3 valves type 6AD4: 6AK4 6BA5. Condensers, resistors, etc., 12/6 each. Type (2) contains 4 valves, etc. **15/- each.**

Valves 6AK5 **10/ each**
Formers TVIF. **1/ per dozen**

Telcon shielded single core cable No. TA518, 9d per yard.

TO CLEAR
¼in High Q Iron Slugs with ¼in brass adjust screw. **6/ per Doz.**
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1,000 ohm Relays **7/6 each.**
5CR522 Genemotors **12/6 each.**
PMG Jack Cords, red or black less plugs **6/ per doz.**
Fuse Holders, 1 hole mounting, **2/6 each.**
Oil filled Block Condensers, .1 7500 volts **7/6 each.**
Brand new Slydlock Fuse Holders **2/6 each**
5 amp Fuses **2/ per doz.**

I.R.C. RESISTORS
15 ohms 3 watts **1/ each.**
42 ohms 3 watts **1/ each.**
400 ohms 3 watt **1/ each.**
25 ohms 20 watts **2/6 each.**
75 ohms 20 watts **2/6 each.**
47 ohms 30 watts **2/6 each.**
1700 ohms 30 watts **2/6 each.**

CHOKES
5.5 Milli Henries **5/6 each.**

WELWYN RESISTORS
100K 1% **1/ each.**
150K 5% **1/ each.**
900K 1% **1/ each.**

RECO RESISTORS
3.9 ohms 5 watts **1/ each.**
36 ohms **1/ each.**
120 ohms **1/ each.**
910 ohms **1/ each.**

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SCR522 Circuits **12/6 each.**
P.M.G. Key Switches. Ideal model railway intercoms, etc. **2/ each.**
6CQ6 Valves **5/ each.**
7 Pin Hi Insulation Sockets **9d each**
7 Pin Sockets and Shields. **2/ each.**

Westinghouse Rectifiers
BRAND NEW
Type 18 RA 1-1-8-1 **2/6 each**
Type 16K4 **1/6 each**
Type 16HT4 **1/6 each**
Type 12 Westector **1/ each**

ALL ARTICLES PLUS FREIGHT

powered transmitters. A recent check showed that Radio Teheran in Iran is using 3985, 7070, 7165 and 11730KC. The home service in Persian is from 1245 to 1730GMT, and the foreign service on 7070 and 11730 commences with Russian, 1730, Turkish 1800, Arabic 1830, English 1930, French 2000 and Persian 2030 to sign off at 2130 GMT. The other two frequencies continue with the home service of Radio Iran to sign off at 2030.

PAKISTAN, in its service from Karachi to Europe, is on the air in English 1945-2030 on 7135 and a new frequency of 6250KC. This new channel is outside the band, as are 7020 and 9820KC also heard in recent weeks.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are in GMT, add 8 hours for Perth, 10 hours for Sydney, and 12 hours for Wellington time. All frequencies are in kilocycles.

CONGO REPUBLIC, Leopoldville, has a new frequency for its regional station in Elisabethville, which is giving good reception on both channels, 5958KC 10KW, and 11870KC 100KW. The stations are on the air 0400-0700, 1000-1230, 1400-2030 in French and vernaculars. News in French is at 0430, 0530 (from Leopoldville), 0630, 1030, 1200, 1830, 1845 and 2000, the 1830 and 2000 news in French is also relayed from Leopoldville.

INDONESIA is expected to be heard with a very powerful voice when new transmitters are installed. A report from East Germany states that the "Voice of Indonesia" has ordered ten 100KW short wave transmitters. For many years the station has been using American RCA transmitters of 100 and 50KW, which were installed by the Americans in 1948. The transmissions from Djakarta are now on the air with a service to Australia, New Zealand, Asia, Europe and Africa.

MALAGASY REPUBLIC has been heard in a new service in English and French. The announced frequency is 15270KC, but is more like 15255KC from reports received. The service often opens at 1700, at 1730 there is QSL corner, and the full transmission appears to be 1600-1735. The station is presumed to be using its new 100KW transmitter in this program, which is beamed to Europe.

BROADCAST AND TV

NEW ZEALAND — Complete details on the call signs and frequencies allocated to new N.Z.B.C. stations have been announce The stations to open this year are, 1ZO Tokoroa 1480KC; 1ZA Taupo 1500KC 1ZU Taumarunui 1520KC; 2ZE Blenheim 1540KC and 2ZH Hawera on 1560KC.

A change in call sign and frequency ha been made by the N.Z.B.C. station at Gisbourne. Formerly 2XG on 1010KC it i now 2ZG on 1060KC. The new channe should give better coverage in the North Island area as the former frequenc suffered interference from three Australia stations, while on 1060KC the only interference will be from 4SB, Kingaroy, Queensland.

TELEVISION FOR TAHITI-NEW CALEDONIA

According to a press message new television stations are planned for Tahiti an New Caledonia, as well as an increase i the transmission hours of the radio service The television station for Radio Tahiti i to be brought into service towards the en of this year. The radio service is planne to be stepped up to 22 hours a day fro Papeete. A radio centre is to be built i New Caledonia, and it too will soon be o the air for 22 hours a day. Radio Noume New Caledonia, will be increased in pow so it can be heard in all countries bordering the Pacific.

ANSWERS TO CORRESPONDENTS

When writing to us:—

- **Please give your name and full postal address, including the State . . . . N.S.W. &c.**
- **Please write the above information clearly or, for preference, print it in block letters. Your co-operation will facilitate delivery of replies by mail, where such are called for.**

SIMPLE CIRCUITS

.S.S. (Berne, S.A.) writes requesting more simple circuits, one valve, one transistor, etc.

'e have a wide variety of simple circuits r beginners available through our query rvice. Also, rest assured that the beginers will not be forgotten in future issues. rojects for beginners are constantly in view.

AMATEUR TRANSMISSIONS

o Name (Willoughby, N.S.W.). This reader describes how he heard one half of an amateur conversation while working on a broadcast set tuned to the high frequency end of the broadcast band, around 1300KC. He expresses surprise that amateurs are allowed to operate on the broadcast band.

our surprise could be justified, because nateurs are not licensed for operation on e broadcast band. However, we doubt ether this was what was happening. nateurs are licensed for operation on 1.8 1.86MC (1600 to 1680KS), which is just low the broadcast band. It is conceivable at a nearby amateur using this frequency uld be heard on a broadcast set by sheer ight of signal. A check on the call sign u quoted shows that this amateur lives your suburb, and so may be only a few ndred yards away. If the breakthrough ould prove to be a nuisance, a simple p tuned to the amateur's frequency and nnected to the receiver aerial system ould cure the trouble. Alternatively, the ateur may be using a much higher frency band but rendered audible by his nal beating with a harmonic of the illator in your receiver.

TV ON A PORTABLE

. (Hawthorne, Vic.) asks how it was possible to receive transmissions from Channel O on his D/W portable radio on approximately 17MC.

ile we cannot be sure of the exact exnation it is probable that harmonics he receiver oscillator could beat against strong signal of the TV station and duced a mix which falls into the interliate frequency range of your receiver. such frequency could be the third nonic of your oscillator when it is d to approx. 17.098MC.

CURRENT FLOW

. (Frankston, Vic.) is another reader who has commented on the recent argument about current flow in an unloaded aerial coil. He suggests that there is a convention to define "induced current" as that which flows in the presence of an external load. If current flows without load, it would involve a rather ridiculous expedient of calling it an "imaginary current."

ost of the points raised in your letter been covered by parallel correspone and our comments, as published last h. We simply hold to the view that a current does flow in an unloaded coil, representing the cyclic movement of charges in the presence of an alternating magnetic field. Further, that this current is modified in amplitude and phase by the connection of an external load. If an effort of imagination is required, it is to escape this position and to reconcile the orderly movement of charges in a non-loaded conductor with a non-current If some clarification or re-ordering of definitions is necessary, well and good. In fact, we didn't start out to question definitions; we made a statement based on fundamentals. The statement has been challenged but certainly not disproved; the original challenger has, in fact, accepted its validity.

RECORD PLAYER

W.K.O. (Nth. Balwyn, Vic.) asks for the power output of a simple Record Player described in the August, 1950, edition.

At the time that this circuit was featured crystal pickups were available which could develop sufficient voltage to drive the 6M5 close to its full output of approximately 3.5 watts. However crystal pickups now in use have sacrificed output in favour of better frequency response and results with this circuit might be disappointing. We recommend that you consider using our later circuit, from the October, 1959 edition, which incorporated a 6BM8 triode-pentode valve.

ACOUSTIC FILLING

Reader (name and address supplied but not published by request) says that, during the manufacture of foam plastic, an intermediate step yields "bloated" granules of very light weight, yet high density. He wonders whether these could be used as filling material for enclosures along the lines of the "Playmaster Bookshelf" units.

Without knowing the material or having the opportunity to examine it, it is hard to say but we are doubtful about its suitability. The filling materials originally specified are fibrous in texture and interpose countless strands in the path of any air which wants to move, thus constituting a particular quality of acoustic resistance. If a more cellular type of material is used, the action may not be so much diffusion of air throughout the whole volume, as a localised air lock behind the speaker. In the granular form you mention, this effect may be at a minimum, reaching a maximum when the same material is compressed into the rigid shapes used for packaging. At this stage the surface is virtually non transparent to air. Some other reader may possibly have a few clues about the material of which you speak.

SHORT-WAVE RECEIVER

J.D. (Canberra, A.C.T.) writes asking our recommendation of a receiver capable of picking up short-wave broadcasts from such countries as Greece and France.

Unfortunately short-wave reception is a variable commodity. It is necessary to select the correct time of day and frequency to suit prevailing conditions. Even with the best receiver built satisfactory reception will not be available if conditions are not right. For best results the receiver selected should approach communications quality, such as our 1965 Communications Eight, and be connected to a reasonable aerial system.

MORE CARTOONS

A.K. (Bathurst, N.S.W.) says he likes the journal but feels that it could stand to be brightened up by the use of more cartoons and cartoon-type headings.

A few cartoons might not be a bad idea but, in the past, they have tended to be crowded out by pressure of other material. On the other hand, too many cartoons and too many cartoon-type headings could introduce an air of flippancy which might not be an advantage. We have noted your request for "Answer Man."

HALL EFFECT

E.C. (Heidelberg, Vic.) comments on page 53 of our January issue and mentions that proposals for the use of Hall Effect in radio receivers have been made from time to time through the years.

Thank you for your further comments. For readers' interest, our correspondent mentions a patent taken out by Franz Skaupy in Germany; also mention of the Hall Effect or "Corbino Effect" in a book by Campbell "Galvanomagnetic and Theromagnetic Effects," published first about 1922 and reprinted some time later.

"ELECTRONICS Australia" INFORMATION SERVICE

TO assist readers, "ELECTRONICS Australia" conducts a technical information service. Conditions governing this service are set out below:—

(1) Address letters to: Assistant Editor, "ELECTRONICS Australia," Box 2728, G.P.O., Sydney.

(2) Requests for copies of circuits or technical information requiring a postal reply must be accompanied by postal note or stamps to the value of TWO SHILLINGS. Queries not accompanied by a fee will be answered in rotation on these pages.

(3) For the 2/ fee, we will supply circuit data, as available, from our files. The amount of data available varies, but in no case can it include information additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for circuits will be answered more speedily if they are not complicated by questions requiring the attention of technical personnel Where articles are not on file we can usually provide a photostat copy at 2/ PER PAGE.

(4) The information service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits. Please note that the inclusion of an extra fee does NOT entitle correspondents to special considerations.

(5) The editor reserves the right to return fees or to limit the scope of an individual reply when it is felt that a partial answer will be better than none at all.

(6) In addition to the above service, chassis blueprints are available for most of our projects showing the position of holes and cutouts for metal-working, but containing no details of wiring. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost 5/ each. Original photographs of most projects are also available, from 5/ for a 6in. x 8in. glossy print, postage 9d extra.

(7) "ELECTRONICS Australia" does not deal in radio components nor will we debate the relative merits of competitive products. Prices and specifications should be obtained from advertisers.

(8) Technical queries are not answered by telephone.

(9) We have no file of circuits for commercial radio or TV sets, etc.

AMPLIFICATION

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A. C. E. RADIO

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136 VICTORIA ROAD, MARRICKVILLE — 51-3845

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4 TRACK DECK

£17/15/-

2 Track, 3 Speed.

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Latest ½ Track. Hi Fi.

£4/15/- Pair

New Telephone Amplifier

Transistorised.

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VERNIER DIALS 3 INCH 20-1 RATIO

T-503	1	5	0

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12v. D.C. Input. 300v. 150Ma. Output plus 150v. Output.

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28v. Input. 500v. 200Ma Out. plus 250v. Output.

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12v or 32v Input to operate TV Sets. 150 Watts.

£29/17/6

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Feb. and March R. TV & H.

106

WIRED AND TESTED, **£42**

107

WIRED AND TESTED, **£39/10/-**

PLAYMASTER 2

With Wide Range Tuner in Cabinet, as Above. P.P. Output, 7 Watts per Channel. **£39/10/-**

SPEAKER VENTED ENCLOSURES

With 8in Twin Cone Speakers Fitted, **£9/10/- Each**

Vented Enclosures for 12in Speakers. 5½ c. ft. **£11/15/-**

Transistor-Ignition HI-SPARK

Simple installation.
38 K.V. output.
Complete. Tested.
Negative earth.

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Positive earth.

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State voltage and polarity.

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CITIZENS BAND

27.240 Meg Fonet 102B
10 Transistor Transceivers.
Hi-Power. 240 MW.
Range to 10 miles.

£32/10/- Each

BELCON

1 watt. 15 transistor, with squelch provision for two channels. Range to 60 miles under ideal conditions.

£88/-/- PER PAIR

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5 Transistor Amplifier, 2 Watt Hi Fi Output.

6 or 12V input. 3 to 45 ohm output, including Connection diagramatics for mono, stereo, P.A. and inter-com. use.

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Complementary Circuit, Encapsulated unit. Canadian manufacture. Parts for A.C. Power Supply

Mono	£5	15	0
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Improve results in fringe and country areas. No fitting required.

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New 10-channel Tuners.

£7/10/-

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240V A.C. Mono	£5	15	0
240V A.C. Stereo	8	10	0
Battery Mono	9	15	0
Battery Stereo	10	15	0
Battery Mono 45 r.p.m. in Cabinet	4	12	6

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Send for full details on Radiogram Chassis, TV and Amplifiers.

AMPLIFIERS

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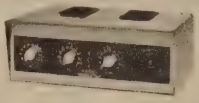

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Multimach Ferguson O.P. transformer input for crystal mike and pick-up with electronic mixing. P.P. EL.84 output. £17/15/-

30 Watt. As above EL34 P.P. £25/15/-

40 Watt. As above EL34 P.P. £37/15/-

60 Watt. As above EL34 P.P. £42/15/-

100 Watt. As above KT88 P.P. £63/17/6

LINE OR VOICE COIL TRANSFORMERS. MULLARD HI-FI RANGE.

5/10 with pre amp base and treble boost. Ultra Linear output £21/15/-

5/20. As above £32/15/-

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6 valve 6 v plus 240v-10 watt £27/15/-

7 Valve 12v plus 240v-12 watt £29/17/6

7 Valve 12v plus 240v-25 watt £35/17/6

INTER. COM. UNITS

2 Station Transistorised

£5/15/-

4 Station including Master

£10/2/6

VARY. A.C.S.

240-270V 50 cycle 5 amp. Provide infinitely variable AC voltage.

£14/15/-

2½ Amp. as above

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New lightweight, fully adjustable units

12/6

As above with buzzer. Complete Morse practise set.

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5 Transistor Amplifiers.

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BM-3

CRYSTAL MICROPHONES

£2/10/-

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3 Band Transistor Portables.
Push Button Operation.

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24 Ranges. Switched.

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9 Ranges Switched.

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15 ohm. Twin Cone

8in	3	10	0
12in	3	19	6
5in	2	5	0

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WITH UNITS

5 Watt 8 ohm	7	5	0
10 Watt 8 ohm	13	5	0
35 Watt 15 ohm	18	0	0

N.B.: As these are American ratings, divide the wattage by 2.

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1965 model. 4-speed.

£10/15/

De Luxe Model.

Fully machined and balanced. Heavyweight turntable. Ceramic cartridge.

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As used in R., TV & H. stereo recorders.
Also operates as 4-track monaural.
Latest hi-fi Michigan heads.

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2-Track Mono **£19/-/-**

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For SSB Receivers.
455 KC. Balanced or unbalanced as required.

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4-Speed Players.
6V. D.C. OPERATION.
MONAURAL CRYSTAL HEAD

£4/17/6

STEREO.

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A. AMPLIFICATION
C. COMMUNICATION
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Push-Pull. 8 Watt per Channel Bass and Treble boost and Cut. Wired and Tested.

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ransistorised. Fountain Pen sized nit for Signal Tracer in Radio. TV and Amplifier Service.

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35 WATT

Channel. Bass and Treble Boost. Twin-Cone Speakers .. £52/10/-
60-Watt, 2 Unit
4-12in Auditorium Speakers.

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brato with foot control and 2 e-set controls for frequency and ensity. £5/5/- extra on above odels.

14 plus 14 WATT

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Input Channels. Bass and Treble st. 2 12in Radial Beam Speak- Perfect reproduction on 20 les.

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Watt. 4 Inputs. Multimatch. V.C. Output.

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1965 COMMUNICATIONS 8

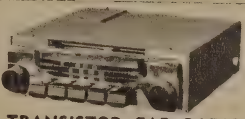
R. TV and H., January

This outstanding receiver for Ham or General use.

Wired — Tested Guaranteed

With mechanical filter.

£20 Extra



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£29 Complete

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5¾" 850ft	1	2	6
3in Mylar L.P. 300ft		10	6
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7in Mylar D.P. 2400ft	2	15	0
10½in Mylar L.P. 3500ft ..	4	15	0

Post 2/6 per Spool.

P.A. SPEAKERS

8 WATT
8in Units in Waterproof Projection Horns.
15 Ohm Voice Coils.

£6/15/-

In Double Ended Flares. Duolateral Coverage.

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Line Output Transformers to suit, 17/6 extra.

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American Rating. 30 Watts. Voice Coil 16 ohm.

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240 Volt A.C. Operation

3 Rate 6V, 12V TRICKLE CHARGE

Trickle Charge Position suits all Batteries. 2V to 12V at rate of 200 to 500 M.A.

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2 amp. 6V, 12V, TRC £5/15/-
3 amp. 6V, 12V, TRC £6/12/6
4 amp. 6V, 12V, TRC £7/12/6
5 Amp. 6V, 12V £7/19/6
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1½ amp., 6v-12v £4/17/6
3 amp. £8/7/6
4 amp. £9/17/6
6 amp. £10/17/6
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Rail or Air Freight on.

Cabinet only £5/15/.
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To R, TV & H specifications. Mountain Ash, Maple or Walnut finish.

Complete £14/5/

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12V Operation.
2 Channel input.
With mixing 15 ohm output.
15 Watt £27/15/-
30 Watt £37/15/-
50 Watt £42/10/-
240 A.C. plus 12VD operation if required. £7/10/ extra.

R. TV & H. STEREO TAPE RECORDER

MARCH-APRIL ISSUE, 1962

Complete kit set as described including Collaro, Stereo Deck. With latest Michigan Heads and required modificatons.

£90/17/6

Steel Cabinet to fit.

£8

Wired and Tested. Complete in Cabinet with Tape. 2 Dynamic Microphones. Guaranteed.

£115

TAPE RECORDER SPECIALS

2-Track, Deck and Amplifier. To build into your own unit.

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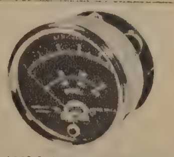
4 TRACK 3 SPEED DECK WITH 10 WATT AMPLIFIER

Latest B.S.R. Deck with footage and level indicator.

£45/15/-



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Wired and tested.

£10/7/6

R. TV and H., July, August issue. State max. revs., voltage, polarity cylinders.

INCLUDING DWELL. ANGLE FACILITY.

£11/12/6

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AND 636 KING STREET, NEWTOWN—51-7008

K 20 CT330

K 20 CT500

C.T.330 20K.OPV

D.C. Volts, .6, 6, 30, 120, 600, 1200, 3000, 6000 A.C. Volts, 6, 30, 120, 600, 1200. D.C. Current, .06-6, 60, 600mA. Resistance, 6K, 600K, 6meg., 60meg. D.B. minus 20 to plus 62. 5 Ranges. Specially suitable for transistor use.

£7/19/6 Post 5/.

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£7/5/- Post 5/.

S.E.550 100K.OPV

D.C. Volts, .5, 2.5, 10, 50, 250, 500, 1000. A.C. Volts, 2.5, 10, 50, 250, 1000 D.C. Current, 10uA, 2.5, 25, 250mA, 10 amps. Resistance, 2K 200K, 2M, 20M. D.B. minus 20 to plus 62.

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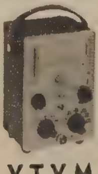

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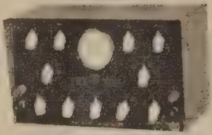

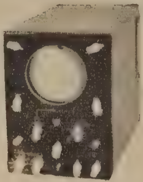

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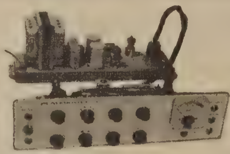

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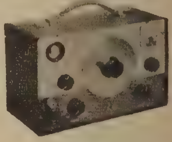

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TECHNICAL BOOKS AND PUBLICATIONS

Counting Techniques

N INTRODUCTION TO COUNTING TECHNIQUES AND TRANSISTOR CIRCUIT LOGIC, by K. J. Dean, B.Sc. Crown 8vo, 236 pages, many circuits and diagrams. Published by Chapman and Hall Ltd., London. Price in Australia 42/6 plus 2/3 post and packing where applicable.

Those students, technicians and engineers ho as yet have had little to do with logic rcuitry, counting circuitry and other spects of computers and who feel that ey had better start soon to familiarise emselves with the concepts and practi- alities of this rapidly expanding field will nd this book most helpful. Those already the field may also find it of considerable se as a reference volume.

The author is a senior lecturer in Physics the Kingston College of Technology, nd in his book he employs his educational aining to good account to succeed in his ated aim—" . . . to explain the principles nderlying such (counting and logic) cir- itry, to show its connection with logical eory, and to differentiate between the aracteristics of some common systems."

The first chapter of his book deals with e transistor, touching briefly upon its story and principles of operation and nphasising the parameters of particular terest to the designer of counting and gic circuitry. The second chapter, some- hat larger, introduces the mathematics and gic of counting. It introduces binary ithmetic; binary-decimal and decimal- nary conversion; octal code; binary- cimal codes; digitising analogue quanti- s; progressive codes; error detecting codes; d Boolean algebra.

The third chapter deals with the design d operation of transistor-resistor logic cuits, using truth tables to introduce the ncepts of "And," "Or," "Nand," "Nor," Not" and more complex gates such as Exclusive Or" and the "half-adder." stables, monostables and delaying elements e also introduced.

In the fourth chapter the author deals th diode logic, and shows how diodes ay be used to carry out many of the gical operations introduced in the pre- ous chapter. In addition, he explains some the circuit features and requirements culiar to diode logic.

Chapter five deals with the use of bistable d monostable elements in counting, deal- first with simple binary counters and ogressing to modified binary counters ch as the decade counter). The author plains the use of the monostable circuit delay and timing circuitry. The following apter deals with the Schmitt trigger and able circuits.

Output and display methods are treated chapter seven, which discusses incan- scent lamp driving circuits, electro- gnetic counters, neon lamps and digital licators ("Nixies") and other types of licator. The idea of a diode decoding trix is introduced.

The eighth chapter deals with special unting systems. Among those discussed "gated feedforwards" counting, one- lse delay systems, reversible counters, rallel counters, "straight" and "twisted" g counters, and ratio counters.

Chapter nine covers arithmetic methods, cussing parallel and serial adders, sub- ction, comparison, multiplication, ratios, ision and exponentials. The three final apters deal with examples of logical tems, types of semi-conductor logic systems and the application of micro-miniaturisation techniques. The book concludes with a bibliography and the answers to tutorial problems set at the end of each chapter.

The author's style is concise and easy-to-follow, and the book can be recommended as above.

Our copy came from the Technical Book and Magazine Co., of 295-299 Swanston Street, Melbourne, from whom copies may be bought by mail. (J.R.)

* * *

THE RADIO AMATEUR'S HANDBOOK, 42nd Edition, 1965. Published by the American Radio Relay League. Soft cover, 700 pages, 6½ inches by 9¼ inches. Illustrated text material both photographic and diagramatic.

Again this year there has been a reduction of pages in this well-known publication —in all 20 pages less than the 1964 edition and happily once more from the catalogue section which is of least importance to the Australian reader. We note that there is a slight increase in the selling price of this volume and this may be the price paid for the absence of the above 20 pages of advertising.

To those who may have in their possession copies of the 1962, 1963 or 1964 editions of this handbook there is little to recommend the purchase of this new volume. It is, in general, a close repeat of 'these editions with a very small amount of new material, a little rewriting and a reshuffle of some sections to give better reading sequence.

However, for those with out-of-date copies or who may not be familiar with this publication, we can certainly recommend it to both the beginner and the advanced student. Starting with basic fundamentals this book presents all the relevant information required by the active radio amateur. Subjects covered are Vacuum-Tube Principles, Semi-Conductor Devices, Single Sideband, Transmitters, Receivers, Antennas, Measurements, and other related subjects too numerous to list.

Either as a theory text book or a constructional guide this publication would constitute money well spent.

Copies for review were received from: McGills Authorised Newsagency, 183 Elizabeth St., Melbourne, Vic. Also from The Technical Book and Magazine Co. Pty. Ltd., 295-299 Swanston St., Melbourne.

Australian price 58/6, postage 2/9.

* * *

TRANSISTORS IN CLASS B COMPLEMENTARY SYMMETRY AUDIO FREQUENCY AMPLIFIERS, by H. R. Wilshire and W. R. Eason, and 450-MILLIWATT COMPLIMENTARY SYMMETRY AMPLIFIER, by W. R. Eason. Published by the Applications Laboratory of the Amalgamated Wireless Valve Co. Pty. Ltd., and reprinted from "Radiotronics" of February, 1964. Gives theoretical and practical design details for 150mW, 300mW and 450mW complementary symmetry transistor amplifiers for audio. (A.W.V., Radiotronics Department, P.O. Box 63, Rydalmere, N.S.W.)

* * *

NATIONAL BUREAU OF STANDARDS TECHNICAL NEWS BULLETIN, December, 1964. Vol. 48, No. 12.

Includes a report of actions taken by the 12th General Conference on Weights and Measures; an explanation of the new

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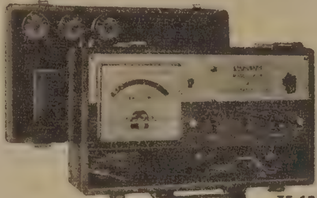

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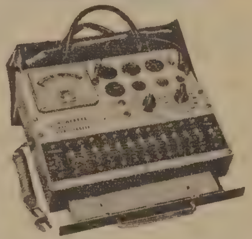

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international atomic definition of the second; an article on solar flare ionisation and another on reversible magnetic permeability; an index to Vol. 48, and a list of recent publications by the N.B.S. staff in their own and other U.S. journals. (Subscription 2.25 dollars per annum, from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402.)

MINIWATT DIGEST for April, 1965 (Vol. 4, No. 7) has an article dealing with approaches to "practical automation," and another describing a proximity switch process timer with application in Diesel alternator control. Data charts are given to aid in the selection of LF power transistors, and there is an article dealing with developments and uses of Philips "fine wire bulk packs." (Miniwatt Electronics Div., Philips Electrical Pty. Ltd., 20 Herbert St., Artarmon, N.S.W.)

RADIOTRONICS for February (Vol. 30, No. 2) has articles on 12-volt audio amplifier and converter designs using silicon transistors, thermal runaway in HV switching transistors and transistor amplifiers and oscillators at 1000MC. (Radiotronics, P.O. Box 63, Rydalmere, N.S.W. Subscription £1 per annum.)

MULLARD OUTLOOK for March-April (Vol. 8, No. 2) has major articles concerning the 95BFY metal-oxide-silicon (field-effect) transistor, silicon planar integrated circuits, voltage controlled oscillators, drive circuits for the Z504S counter tube, the use of "Laddic" in a fail-safe fire alarm, analogue to digital converters, direct readout counters, Hall effect measurements, determination of e/m and determination of the Curie point of ferroxcube. (Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney.)

HEWLETT-PACKARD JOURNAL for December, 1964 (Vol. 16, No. 4) is devoted to the use of Step-Recovery Diodes in the generation of nanosecond pulses and microwave harmonics. (Australian representatives are Sample Electronics Pty. Ltd., 9-11 Cremorne Street, Richmond E.1, Victoria.)

MARCONI INSTRUMENTATION for December, 1964 (Vol. 9, No. 8) describes a new white noise test set, a 100KC crystal filter as used in the new wave analyser, a new wide-range R-C generator and an AF transmission measuring set. (Marconi Instruments Ltd., St. Albans, England.)

B.B.C. ENGINEERING MONOGRAPH No. 55 contains a review of television standards conversion, by A. V. Lord and E. R. Rout. (B.B.C. Publications, 35 Marylebone High Street, London, W.1. Subscription £stg1 per annum plus postage.)

STANDARDS ASSOCIATION OF AUSTRALIA advises release of new standards and amendments. The first relates to Electric Blankets edition AS164 (revised) and is available for 8/6 plus postage. An amendment to C127 is available without charge while a reprinted C167 is available for 6/. The second release relates to high voltage testing techniques for the electric power industry, the standards being AS C328 and AS C338 available for 30/ and 15/ a copy respectively. Postage on all above items is extra and enquiries should be addressed to the Association in the nearest capital city.

THE INTERNATIONAL TELECOMMUNICATION UNION has just published the General Plan for the Development of the International Network for 1963-1968. This replaces the volume covering the period of 1958-62. The sale price has not yet been fixed but is expected to be between 50 and 100 Swiss francs. (International Telecommunication Union, Place des Nations, Geneva, Switzerland.)

FORUM—Continued from page 51

have had time to make up his mind about Channel 10 also!

It all leads, ultimately, to a speculation as whether the most satisfying thing might not be to buy a monoscope or pattern generator of some kind or other, and gain the satisfaction of gazing at an image, the characteristics of which are all under the viewer's own control.

He thus reaches the visual equivalent of the Flanders and Swann item "Song of Reproduction." If the program sources aren't good enough, the audio hi-fi enthusiast can peak everything up and fill his room with beautifully reproduced sine waves, white noise or just plain scratch!

And, after this burst of whimsy, our correspondent admits to being prepared to settle for a well-designed commercial receiver with direct coupling, regulated EHT and with vertical and horizontal drives sufficiently accessible and effective to allow the picture to be set up for full visibility and proper aspect ratio, mask notwithstanding.

I've a sneaking suspicion that, in these circumstances, he might even overlook the technicalities long enough to enjoy an occasional TV show!

Getting away from technicalities, the letter on page 51, a somewhat abbreviated paraphrase of the original, raises a number of interesting questions.

First of all, C.C. says that he has never saved a penny on the cost of units against the ready-assembled article.

This could be taken to mean that, for all the items C.C. has built, he could as cheaply have purchased the commercial equivalent. If so, then I can only remark that he has been extraordinarily unfortunate in his choice of projects or of parts supplier!

It is true that there are some items which it is not economical to build, notably items like mantel radios, transistor portables, television receivers, electronic flash guns, all of which are massed produced (in some cases overseas) and sold with slim margins and, sometimes, at "throwout" prices.

Knowing this to be so, we describe such items rarely, these days, and then mainly for tuitional purposes.

However, there are other items where very substantial savings can be made. A whole generation of do-it-yourself hi-fi enthusiasts have saved themselves a lot of money with R., TV and H and similar audio projects.

Our correspondent mentions the "Communcations 8" receiver which leaves little change out of £100 by the time it is finished. That sounds like a lot of money—until you go looking fo a commercial all-band communicatio type receiver with equivalent facilitie and specifications.

Taking the other viewpoint, C.C. migh mean that home construction has save him nothing, in that he could alway have bought equipment ready wired an assembled for virtually the same as th parts to make it.

Buying from the same source, I don think that this is strictly true, becaus there is generally a margin between th unassambled kit and the same thin wired and tested. Admittedly the margi is often surprisingly small but this doesn mean that the separate components hav been subjected to wanton overcharg rather is it a measure of the economi which the firm has been able to effe in equipment assembly, using bulk stock job-lot purchases and so on.

As we pointed out in the March issu it costs real money to sell individu components and it likewise costs re money to hold bulk stocks and the from them, select and package all th assorted items required in a kit.

C.C. seems to think that this situatio is worse in Australia than anywhere els I doubt it. Perhaps it has changed sin he last made a careful study of it ove seas. I do know that the problem regarded very seriously in the U.S.

The thinking that an IF transform is "just an aluminium can and a fe turns of wire" is hopelessly astray.

In actual fact, the average Australi home constructor demands an IF tran former that is electrically efficient, w finished, well packaged, accompanied data and of just the right type to suit t application he has in mind. Try to me that demand and you'll soon find o where the money goes.

Am I on the side of high prices?
. . . on the side of realistic thinkin

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AR7, £20. Freq. meter SCR-211, £10 and S, £5. 9 Down Street, Brunswick, Victoria.

GOODMANS Axiom 80 speakers. 2 RU180 baffles. Unused. Bargain, £75 lot. risbane, 66-9737, Queensland.

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Hi-Fi News
THE MONTHLY NEWS SHEET FOR ALL HI-FI ENTHUSIASTS . . . . MAY, 1965

KEF SPEAKERS
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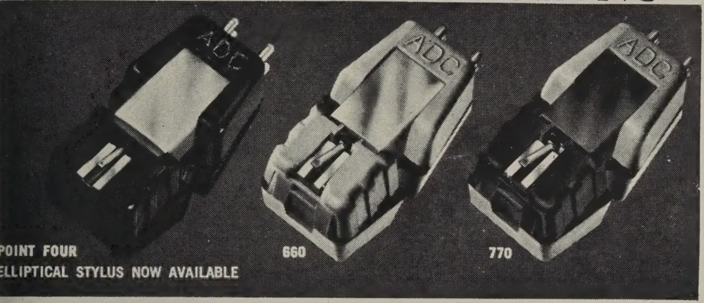
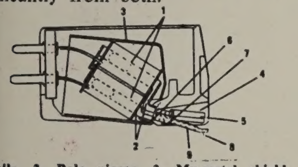
ENGLAND'S LEADING AUDIO EQUIPMENT CRITIC RATES ADC OUTSTANDING



ADC cartridges are distinguished by he exceptionally low mass of the moving system, which is genuinely below ll others and results in superior quare-wave response.

The following is an extract from a 'echnical Report by Percy Wilson in The Gramophone," England:—

The construction is based on a new rinciple which I called the "induced nagnet" principle. It is a sort of cross etween the older GEC "variable re-ıctance" idea and the later Elac moving magnet" idea but differs ignificantly from both.



Coils. 2. Pole pieces. 3. Mu-metal shield. Stylus assembly. 5. Magnet. 6. Armature. Pivot block 8. Stylus. 9. Aluminium canti-ver tube.

The ADC "Point Four" design is everal years ahead of its time and has ad to be scaled down in the 660 and 70 models to meet current practical olitics. It is to the credit of the comany that they have made an advanced odel available to those who wish to ahead of the times, while at the me time catering for those whose nbitions are more moderate.

One other preliminary observation hich should appeal to the technician ther than the ordinary reader. It ems to me that one of the most editable features of this design is its treme simplicity; no screws or stuck- pieces permitting of uncontrollable tolerances; no undue reliability on accurate air-gaps. The length of the cantilever and the mounting of the stylus can be accurately controlled. And here, be it remarked, the cantilever is not unduly long and is tapered, so that any anti-resonance it may impose on the response is above 20 Kc/s (This is the reason for the falling away — a desirable feature — of the response above 16 Kc/s). The one really crucial feature of the design is the hinge, and to this most meticulous care is being given. In other respects (even in magnetic strength and gap distances) the tolerances are wide. To my thinking this is a masterpiece of design and I congratulate the designers, wholeheartedly, upon it.

For brevity, I give only the measurements for the Point Four and the 660 cartridges. Those for the others were similar. For the Point Four and the Point Four E the bias corrector on the arm was put out of operation: at the prescribed playing weight it would over-correct and that, as I have consistently warned, is definitely worse than under-correction. The waveform, in all cases, was exceptionally good, and no tracking difficulties were encountered at the minimum playing weights specified.

For all practical purposes the responses are identical and near perfection. Those for the Point Four E and 770 were just as good.

On the CBS frequency records no significant differences were found. The response began to fall away above 16 Kc/s and was 6 dB down at 20 Kc/s for the 660 and 4 dB down for the Point Four.

No obtrusive resonances or anti-resonances were observed and the wave-form on the proper channel (e.g. the LH when using a LH modulation) and on the wrong channel (e.g. the RH when using a LH modulation) were both clean and undistorted.

Listening tests have confirmed these outstanding results. The Point Four E is perhaps a little crisper than the Point Four and one could persuade oneself that there was less intermodulation. Certainly these fine points would not be observable with any but the very best pickup arms and most meticulous playing conditions.

For ordinary playing conditions, indeed, my colleagues and I are convinced that more consistently good results are likely to be obtained with the 660 model which has a smaller tip compliance and is therefore not so sensitive to accurate adjustments of alignment, playing weight, height and so on. After all, a tip compliance of 20 is entirely satisfactory for normal, present-day use, or even 15, the compliance of the 770, for that matter. For automatic turntables, even the best of the modern ones, the 770 would be our choice. PERCY WILSON.

Makers' Specification:

	Point 4 E	Point 4	660	770
Price (in Australia)	**£35**	**£30**	**£20**	**£13**
Compliance (cu)	30	30	20	15
Tip Radius	.0002 .0008	.0004	.0007	.0007
Playing Weight (grams)	¾ to 1¼	¾ to 1¼	1½ to 4	2 to 5
Load (K ohms)	50	50	50	50
Output (mV) at 5.5 cm/sec	5	5	7	7
Channel Separation (dB) 50 c/s to 8 Kc/s ..	30	30	30	25

All have 15° vertical rake

Decca Test Record SXL2057

Frequency c/s	12K	10K	8K	6K	4K	2K	1K	500	250	125	60	40
Point Four												
LH dB	+2.5	+2.5	+0.5	−0.5	0	0	0	0	−0.5	−0.5	−1	−1
Lxt	−23	−22	−23	−24	−26	−26	−20	−20	−16	−13	−15	−21
RH dB	+2.5	+1.5	+1.5	0	0	0	0	0	0	0	−0.5	−0.5
Lxt	−13	−19	−23	−25	−25	−30	−20	−21	−21	−21	−22	−20
Model 660												
LH dB	−2.5	−1.5	−1	−1.5	−0.5	0	0	0	+1	0	0	+1
Lxt	−22	−22	−20	−21	−23	−26	−25	−20	−16	−13	−14	−22
RH dB	−2.5	−2	−1	−1.5	−1.5	0	0	0	+1	+1	+2	+1
Lxt	−28	−25	−20	−19	−20	−22	−22	−22	−19	−21	−23	−20

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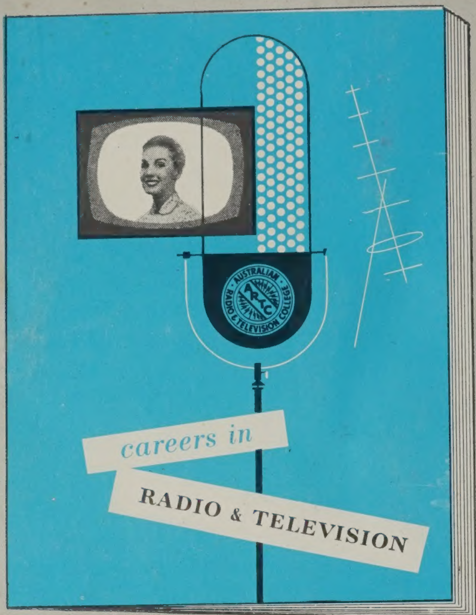

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